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Belgians, fleeing from German oppression, escaping through the electrified fence at the Dutch border by means of a barrel

The Road to Freedom Through an Empty Barrel

By a Belgian Refugee

TO one not conversant with all the circumstances, it might sound like a fairly simple proposition to leave Belgium via the Dutch border. In reality, it is anything but that. In the first place, the Hun realizes full well that in order for a man to escape over this frontier, it is first necessary for him to reach the frontier. Now Belgium is very small, as countries go; but she is not so small that one flying leap will take a man from any part of her territories into Holland. So the German has tried to minimize the probability of Belgian citizens getting close enough to the northern boundary to get across it.

In the first place, it is "verboten" to travel from one place to another without a permit, or Passagierschein, signed by the military authority. This permit states the exact route of travel, the date of departure and arrival, and the date and itinerary for the return; so it is a matter of the greatest difficulty for a stranger to sojourn for any time in the frontier districts without being detected. Finally, nobody except those who lived there before the war is on any pretext allowed within so many miles of the border.

Nevertheless, Belgians escape into Holland in considerable numbers, and will continue to do so. The usual procedure is to wait until the soldiers garrisoned at the frontier villages are relieved by new men. During the first few weeks it goes without saying that these new sentries will not know the names and faces of all the villagers who are entitled to the privilege of the locality; so during this period it is comparatively easy for Belgians from other parts of the country to hide among the local population. It is not even out of the question to obtain a forged 'pass or carte d'identite. So, once near the border, at the right season, there is no great risk attached to remaining there for the few days necessary.

Of course, the Huns have put up a barbed wire fence about ten feet high along the whole frontier between Holland and Belgium. This fence does not constitute merely a physical impediment to crossing, for each wire carries a high voltage current, supplied by the power stations at Antwerp and other municipalities. So to touch a wire means instant death.

Of course, even such a fence would be of little use unless well guarded. So at intervals of 200 meters, or approximately the same number of yards, there is a sentry box, with a German sentry patroling his short beat. This is quite adequate to prevent any organized attack upon the wire, and reduces the would-be escaper to some expedient for getting over or under or through the wires in a hurry, while the sentry's back is turned. It is unnecessary to state that, by preference, a moonless and stormy night is selected; but perhaps it is not fully realized, over here, that during the autumn and winter season in Belgium it is raining on six nights out of seven, so that it is not hard to make a good guess.

On the prearranged night, after dusk, the fugitives come together in one of the numerous cafes outside the villages, and there wait until the guides who are to lead them across announce that the hour is come. These guides are usually men who for years have smuggled sugar and tobacco between Belgium and Holland; they have covered the route so often that, even in the pitch dark, they know every little path and ditch and brook.

The territory on both sides the border is moorland covered here and there with clumps of woods of Scotch fir. The main roads are carefully avoided; strict instructions are given not to speak a word; and all go barefoot in order to reduce to a minimum the amount of accidental noise. There is one guide for every ten persons. He walks in front and the fugitives follow in single file along the extremely narrow paths. An interval of about two hundred yards is left between each two groups, so that, if any group have a dangerous encounter, the others have plenty of time to make for safety.

Having come near the live-wire fence the real danger begins. There are several recognized ways of crossing. One can climb over it by means of a double step-ladder, not unlike the model so commonly seen in domestic service on this side of the water; one can also creep under it where it passes a dried-up or dammed ditch or brook, doing a little emergency excavation to enlarge the passage if this be necessary. But the safest way, and the one followed by the party with which the writer came out of Belgium, is to creep through the fence in a tunnel improvised from a flour or wine barrel stuck between two wires. As dry wood is a non-conductor, there is no danger of coming in contact with the current, provided the night is not too wet a one. If it is, the best measure of safety possible is obtained by means of a packing of rubber cloth between wood and wires.

The German sentry, whom one might expect to constitute a formidable obstacle in the way of success, is really one of the smallest sources of concern. The usual time of crossing is between one and three o'clock A. M.; and at such an hour, it is quite natural that the sentry would rather stay in his box than walk in the rain. Or perhaps he is a man of cautious instincts, and does not care to come near a band which he knows will outnumber him, and whose members can handle a revolver as effectively as he can a rifle. Or, in default of either of these alternatives, it may be suspected that the worthy sentry is actually in league with the guide, who can well afford to split his fee of four dollars per head (and upwards) with one or two deserving Germans.

Once through the wires, one is not quite through the adventure. It is still necessary to pass over a narrow strip of neutral territory, into which, presumably, a German sentry would not hesitate to shoot if he saw reason to do so. On the far side of this strip one meets the first Dutch sentries; and after a few formalities one stands a free man again on Dutch soil.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The U-Boat Off Our Coasts

THE increasing activity of German U-boats off our coasts is presumptive evidence that the Submarine campaign in European waters is a failure. Were it not so, that is to say, if the Germans were sinking merchant ships at the rate which obtained a year ago, they would never remove a single U-boat from the crowded waters of Europe and send it to cruise along the 2,000 miles of our Atlantic seaboard where the ships of importance are few and far between.

The Germans have sent their submarines to our coasts in the hope of terrorizing the civilian population and starting a demand that our destroyers and chasers be withdrawn from European waters for the protection of our own seaboard. In this they are going to be disappointed; first, because the American people are perfectly well satisfied to leave all questions of naval strategy and tactics to their well-proved Navy Department; and, secondly, because the Navy Department itself realizes that it is well worth while to lose a few schooners and an occasional second-rate merchant ship for the sake of giving safe convoy to the millions of American troops which we are sending, and shall continue to send, to the European battlefields.

If Bernstorff, von Papen, Boy-Ed, and the rest of the crew of ambassadorial spies which Germany maintained in this country are able to interpret the American mind, they will tell the Kaiser that the mass sentiment which forced upon our Government strong measures of preparedness, will loyally back up its Government now that the nation is armed and equipped, and leave the disposition of its forces and the control of strategy and tactics to those who are in power.

It is for us as a people to maintain our sense of proportion; to climb to those heights of observation from which we can get a perspective view of the whole conflict. If we do so, we shall realize that so long as our Navy Department is able to give safe conduct to our troop ships and the major units that carry the necessary arms and supplies, we can afford to lose a few fishing boats and now and again a coast-wise steamer.

At the same time, we must remember that we have not as yet, by any means, stretched our manufacturing capacity to the limit. We can do, and we ought to do, very much more than we have done or are doing; and we ought at once to construct a fleet of vessels, specially designed to meet and defeat this U-boat warfare in our own waters. For this purpose we have a well-proved type of boat ready to hand in the most excellent boat with which that famous Italian officer, Rizzo, sank, in a single engagement, two of the largest Austrian dreadnoughts. These little craft have a high speed of, we believe, between 25 and 30 knots, and they carry two 14-inch torpedo tubes in the bow. They have high-speed underwater lines, and, unlike our Eagles, they carry a flaring bow which makes them capable of maintaining speed against a head sea. An excellent boat for our waters would be one of this type, somewhat enlarged to enable it to carry a 6-pounder chaser gun and a machine gun and a large supply of depth bombs at the stern.

If all coast-wise traffic and all incoming and outgoing Atlantic shipping were instructed to keep within the three-mile limit while off our coasts, and if this belt of water were thoroughly patrolled by a fleet of fast motor torpedo boats of the improved Italian type, it is our belief that the Germans would very early come to the conclusion that it was not worth while to send U-boats to this side of the Atlantic.

Incidentally, the question comes to our mind as to whether, as part of their American submarine campaign, the Germans have not established a floating submarine base—say some 500 miles off our coast. German raiders have frequently managed to slip through to the Atlantic, and it should be possible for a fast mother ship to do the same. In view of this, we ask whether it would not be worth while temporarily to assign a couple of our 22-knot battle cruisers to the task of scouting in the Gulf and between the West Indies and the Newfoundland coast in search of any such vessels. Our battle cruisers would be more than a match for any armed mother ship; but to send any of our lighter cruisers on this mission might expose them to the risk of being sunk by heavier gun fire.

The Enemy in Our Midst

THERE is now running, in many weeklies and monthlies, an advertisement of the Committee on Public Information warning us of the prevalence of spies in our midst, and of the consequent necessity for guarded speech. A sinister gentleman whose countenance has been admirably worked out by the artist to suggest camouflaged Teutonicism is represented in an attitude of camouflaged attention upon the conversation of two ladies behind him, who, the reader is left to imagine, are indulging in a delightful exchange of high Government secrets.

Without question, there is a marked tendency on the part of the public to discount such warnings. In spite of the logic of the text which accompanies this picture, we are prone to be left cold by the appeal, to feel that whatever danger exists in the premises is a small and a remote one. What do I know that would be of value to the German high command, is the unconscious thought of each of us. What is the probability of a German spy being about when I talk? What is the probability, granting his presence, that he will be able to communicate with Berlin? Above all, what infinitesimal chance is there that any little thing I happen to know is not likewise known to a dozen spies?

An interesting tale came to our ears recently—a tale for whose accuracy we can vouch, and which is most pertinent in this connection. A professor at a large eastern university had an idea for a new type of ranging instrument for use on small-arms and machine guns. He believed that a range-finder could be built after this idea which would function more simply and more accurately than any heretofore designed. He worked out his invention to the point where final drawings were in order; but he felt himself incompetent to prepare these with the degree of care and accuracy necessary for presentation to patent office and war boards, so he decided to put the whole matter in the hands of a patent attorney.

In response to the professor's letter, the head draftsman of the firm to which he addressed himself went to the seat of the university and spent a day going over the thing with the inventor. He then returned to New York and began work on the final drawings. He spoke of the matter to not a single soul; and he was as yet the only member of his employer's staff to know anything about the technical details of the invention.

The draftsman in question resides in a small town of suburban New Jersey. A couple of days after his trip to the professor's home, he stopped of a warm evening for a cooling draught at the local drug store. At his side before the soda fountain were a party of young people of the town. And one of these, a youth of eighteen or twenty years, was regaling the others with a circumstantial account of the wonderful range-finder, operating on an entirely novel principle, which had been discovered by a big professor. Not only did this boy name the correct university; he gave a description of the distinctive features of the invention which, while couched in the language of the street, was at once sufficiently accurate and sufficiently complete to have enabled anyone with a fair knowledge of the prior art to work out the whole thing with little difficulty.

Of course, we do not know where the leak was. The professor himself may have talked, some member of his family may have been indiscreet, some assistant who had had to do with the making of the parts or the testing of the ensemble may have been guilty. The bare fact remains that what should have been an absolute secret among two or three people was being freely bruited about in a public place 50 miles from its point of origin, with nothing apparently to prevent its spread throughout North Jersey.

As we have remarked, we are in a position to guarantee the facts. We don't know whether the instrument will be as effective in use as the inventor hopes; we don't know whether it will be adopted for our armies. But all this is beside the mark. In the one alternative, the information should be kept close in order not to give the enemy direct aid; in the other it should be suppressed in order not to breed false hopes.

Spies and propaganda and unconscious sowers of the evil word are on all sides; and the only remedy is silence on the part of all good Americans. Whatever you know or think you know, don't repeat it, in public or in private; it can do no good, and it may do harm. The Government, with the loyal aid of the press, gives the public every facility for knowing the things that it ought to know. If it errs occasionally on the side of over-caution, that is the safe direction for error to take. If an alleged fact doesn't appear in the paper, that is prima facie ground for believing it to be either false or purposely withheld. In either case, if it happens to be something that has come to your eye or ear, there is the best of reasons for not passing it along to anybody else.

The Japanese Bugaboo

THE announcement that our Government has entered into arrangements with its ally, Japan, to send an armed force into Russian territory for the purposes of assisting the Russian people to restore order and set up a government suitable to their aspirations, has laid forever, let us hope, the bugaboo of Japanese covert hostility.

It was always difficult to understand how the belief that Japan was harboring deep-laid schemes against the United States originated; and only when the great war came, with its revelation of the world-wide extent of Prussian intrigue, was the riddle solved. Step by step, as the mask was withdrawn from German diplomacy, the Allied nations realized that it had long been part of the German plan to sow the seeds of national distrust, suspicion, and hatred among the peoples of the earth. We know that Germany, for years, has been the hate-peddler of Europe; and when our State Department made public the infamy of the notorious Zimmerman in his secret overtures to Mexico and Japan, we realized that over the New World no less than the Old, the Prussian had woven his web of hate-engendering lies and innuendoes. Always we have found it difficult to understand why distrust of Japan should have made such headway in this country; for there was but little, if anything, in the attitude and conduct of the Japanese government to warrant that suspicion. The Zimmerman revelation, however, resolved the whole puzzle, and we very little doubt that such estrangement as existed was due, both in its inception and in its growth, to the persistent, subtle and very clever work, not only of the official German Secret Service, but of all the military and commercial representatives of Germany in this country. From Kaiser down, Germans everywhere have persistently warned America and Americans against the so-called Japanese threat. The very term "Yellow Peril" is of German origin.

Pesistently did Captain Boy-Ed and Captain von Papen preach to the officers of our naval and military forces the doctrine that Japan was determined, first to win the control of the Pacific, and, then, at the opportune time, to strike a blow against the Pacific seaboard of this country. Now that our eyes are opened to the origin of all this talk, it is really amazing that it should have taken as strong a hold as it did. The Japanese government is too wise, and the Japanese people, as a whole, are too far-sighted in their outlook and too well balanced in their judgments, deliberately to make an enemy of the United States. Always we have been their friend; always we have treated them with fairness and consideration. Moreover, the rulers of Japan know that in a trial of strength between them and the United States there could be but one ultimate issue—and that, their absolute defeat.

There are jingoes in Japan, as there are in other countries, and they have said and done things which bear the color of dislike and hostility; but these form but a very small and insignificant minority and cannot for one moment be taken to represent the attitude of the Japanese people as a whole, and certainly not of the Japanese government.

Now that we are embarked with them upon the tremendous problem of bringing order out of chaos in Russia, it would be the part of wisdom for us to maintain an attitude of cordial coöperation and complete confidence throughout the whole of the great venture. The Japanese are a proud, idealistic, and sensitive people, and it should be the policy of every American, be he politician, platform orator, editor or journalist, to let the Japanese people understand that we are embarked with them heart and soul in this great crusade (for it is nothing less), to rescue the struggling Russian democracy from the clutches of the German tiger.

New Substitute for Platinum

THE importance of platinum in prosecuting the war is being emphasized daily, and any substitutes deserve careful consideration. A new one, made in Amsterdam, Holland, is an alloy of 11 per cent platinum and 89 per cent gold. The results of various tests made on it show no loss in weight after 20 minutes' treatment each with 25 per cent hydrochloric acid, 65 per cent nitric acid, 96 per cent sulfuric acid and fused borax; after 15 minutes with a fused mixture of potassium carbonate and sodium carbonate; nor after evaporation of 10 cubic centimeters of hydrofluoric acid. A dish weighing 41 grams lost 1 milligram with fused acid potassium sulfate and 0.2 milligrams with fused potassium nitrate (20 minutes each); 7 milligrams with fused caustic potash (15 minutes), and 20 milligrams with a mixture of 96 per cent sulfuric acid and 4 per cent nitric acid (five minutes). It was unaffected by heating for half an hour in a smoky petroleum gas flame. Except for the high loss in a mixture of sulfuric and nitric acids it is equal or superior to platinum ware.

Engineering

Federal Attention to Toolmaking.—In a recent conference between representatives of the War Industries Board, the army and navy engineer organizations, the Fleet Corporation, and the toolmakers, methods were discussed for increasing the output of the plants making machine tools to meet the unusual demands of the day. Suggestions were brought forward for increasing the aggregate capacity by eliminating certain lines from certain shops, and concentrating on the production of a more limited variety. It was also brought out that there are plants which could handle war contracts for machine tools, but which have not had such contracts. A Committee of Manufacturers was appointed to work in conjunction with the Machine Tool Section of the War Industries Board.

Eliminating Cracks in Pavements.—An interesting suggestion was made during a discussion at the recent convention of the American Concrete Institute for the prevention of seepage under pavements. A study was made of the frost action on pavements, and it was found that any deflection of over seven-sixteenths of an inch in 32 feet of width would produce cracks. To avoid this it was proposed that sheets of bituminous material three-eights of an inch thick and running from the top of the curb to a depth of four feet below the bottom of the concrete base would prevent the accumulation of moisture under the pavement and render it proof against frost action. The investigations have not been completed; they are being conducted at Kenilworth, Ill., by Prof. William H. Burger of the Northwestern University, and also at Winnetka, Ill.

Concrete Work in Zero Weather.—During the extreme cold of last winter, a concrete dam was built across Dead River in northern Michigan. Although the thermometer went 30 degrees below zero the dam was completed without any great difficulty. At first, efforts were made to keep the concrete warm by means of steam. Then, when this was found impossible, the concrete was laid and allowed to freeze over night with the idea of removing the frozen top and sides before laying the next run of concrete. This was found to consume too much time and so the experiment was tried of thawing out the frozen concrete with warm water. Then it appeared that fresh concrete warmed to a temperature of 50 degrees would thaw out the frozen layer and make a good bond with the concrete already laid. The dam is now in service, and shows no evil effects of the extremely cold weather.

Fighting Gas in a California Tunnel.—A recent issue of *Engineering News Record* describes the difficulties of constructing the tunnel on the Marine Municipal Water project. The work was hampered by inflammable gas, believed to be marsh gas. This was encountered at about 3,000 feet from the east portal. The gas was ignited by blasts whenever new pockets were opened, and burned until they were exhausted. When the gas was first encountered, some of the men returning to work after a blast, were burned by an explosion caused by their uncovered lights. After that experience, the precaution was taken of fastening a carbide lamp to a pole and holding it close to the roof of the tunnel while the men hugged the floor. This would explode the gas, and the flames would spread along the roof without injuring the men. On two other occasions a quantity of gas accumulated at the roof was accidentally ignited and the flame shot down upon the men. The gas did not seem to be injurious when inhaled, and the men were not obliged to wear masks. The rock was of igneous formation, chiefly black and green serpentine with occasional ledges of diabase.

Timber Facing for a Leaky Dam.—A rock-fill dam was built across the Cucharas River near Walsenburg, Colo., to form a reservoir for irrigation purposes. Owing to lack of funds, work upon the dam had to be stopped after it had reached a height of 100 feet, and it then lay idle for three years. A few years later, the dam was completed by raising it to a height of 125 feet. The toe of the dam consisted of a cut-off wall of concrete running across the canyon; and the dam had a watertight facing of concrete 18 inches thick built in slabs measuring 8 by 10 feet, backed by hand-laid rock. When water was let into the reservoir a great deal of seepage appeared at the toe of the dam where the facing joined the cut-off wall, and a number of cracks developed in the facing, while much water made its way between the facing and the abutment walls. To correct this condition, it was decided to lay down a facing of creosoted timber, this material being chosen owing to high cost of other materials. The timber was laid in three layers—an upper and lower layer of 2 by 12-inch material and a middle layer of 1 by 12-inch stuff. Between the 2-inch plank and the 1-inch plank were laid two layers of felt waterproofing treated with a heavy coating of hot bituminous cement, and voids between the new and old facings were filled with concrete grout. A new concrete slab was formed over the lower end of the new facing to seal the joint with the cut-off wall. This proved to be an efficient cure.

Science

For a University at Cork.—A strongly supported movement is under way in the south of Ireland to have the University College at Cork (one of the three Irish colleges that constitute the National University of Ireland) converted into an independent university. The college has an attendance of more than 500, and is admirably equipped as to buildings and teaching staff.

Magnetic State of Prehistoric Pottery.—An interesting step in the reconstruction of the remote past has been taken by Dr. P. L. Mercanton, the well-known Swiss glaciologist, who has made a study of the magnetic condition of various pieces of prehistoric pottery taken from Swiss lakes. From these investigations he concludes that at the time and place of manufacture the terrestrial magnetic inclination was nearly zero.

Infra-Red Spectrum Photography.—The Bureau of Standards has recently been investigating the feasibility of employing, in stellar photography, plates made sensitive to infra-red rays by application of various dyes, notably dicyanin. It was found that great advantage was got in this way in the spectrum study of stars of the M, N and R classes. The results are detailed in great fullness in Scientific Paper 318, which will be supplied without charge by the Bureau.

Repeating Bastian's Experiments to Produce Life.—Much was heard some years ago of various experiments by which the late Dr. Charlton Bastian, in England, claimed to have produced living organisms from non-living matter. In a paper lately presented to the Royal Society Mr. H. Onslow tells how he repeated the experiments by which Bastian claimed to have synthesized certain symmetrical bodies, resembling Torulæ and other minute organisms, from sterilized colloidal silica solutions which had been exposed for a long period to light, these organisms being capable of reproducing themselves. Although Mr. Onslow used the special samples of sodium silicate reserved for and recommended by Dr. Bastian and followed the latter's directions in every detail, the results indicate that the methods employed yield tubes which are absolutely sterile for all periods up to three years.

Notable Explorations in Africa.—Commandant Tilho, the well-known French explorer of the Sudan, has recently published a report on the results of five years' work during 1912-17 in the hitherto almost unknown region lying along the frontier between the French Sahara and the Anglo-Egyptian Sudan. Tilho was entrusted with the task of pacifying and organizing this region under the French government; and his surveys embrace a band of previously unexplored country extending more than 1,100 miles from the center of Tibesti southeast to the vicinity of El Fasher, in Darfur. His cartographic work fills up a large blank in the map of Africa. He urges the need of a railway through this region, for the benefit not only of the world at large, but also of the natives, who are subject to periodical famines. It is stated that from one-half to three-fourths of the inhabitants of northern Wadai died of famine in 1914. One especially interesting result of his investigations is the disproof of the hypothesis, supported by his earlier explorations, that there is a connection between Lake Chad and the Nile River system. Tilho explored the volcano Emi-Kussi, 11,100 feet in altitude, with an immense crater over seven miles in diameter and 130 feet deep.

Grain-Dust Explosions.—The subject of dust explosions has attained great prominence in recent years especially in connection with explosions of coal-dust in mines and grain-dust in flour and feed mills, grain elevators, thrashing machines, etc. Investigations under both these heads have been recorded from time to time in our columns. The U. S. Department of Agriculture has just published a bulletin on "Grain-Dust Explosions," giving the results of investigations at an experimental attrition mill installed at the Pennsylvania State College, and also reviewing experiments elsewhere. In this connection it may be stated that the Department of Agriculture, especially through the Bureau of Chemistry, is conducting a special war-emergency campaign for the prevention of dust-explosions and fires. Representatives of the department are instructing and aiding the millers and grain dealers of the country in the installation of protective devices and the adoption of safety measures. The results of experiments up to date indicate that (1) every effort should be made to collect and remove the dust from a grinding mill and the surrounding atmosphere; (2) in some cases it is advisable to use inert gases to dilute the oxygen content of the air; (3) all possible sources of heat should be eliminated when there is any danger of having a dust-laden atmosphere; (4) precautions should be taken to eliminate sparks due to static electricity; (5) more use should be made of sheet iron, or other non-combustible material, in milling plants, on account of the great danger from smoldering lumps of grain; (6) revolving dampers appear to be of some value as preventing the propagation of explosions; (7) an automatic relief valve (described in the bulletin) may be of some value as a preventive measure.

Aeronautical

Mail Service Between London and Paris has been successfully inaugurated. The aviator Lorgnat concluded his third round trip on June 8th in five hours and fifteen minutes. The return voyage was rendered difficult owing to the strong head wind and deep air pockets. "My observer and myself were really seasick, as though pitched and tossed on a heavy sea," said Lorgnat after landing.

Our Giant Bombing Planes.—Speaking recently on the Nation's aircraft program, John D. Ryan, Federal Director of Aircraft Production, announced that the United States now was producing airplanes weighing 15 tons and equipped with four motors of the Liberty type. Mr. Ryan intimated that the larger types of bombing planes would be made in the United States, but that the smaller scouting and battleplanes would continue to be manufactured overseas.

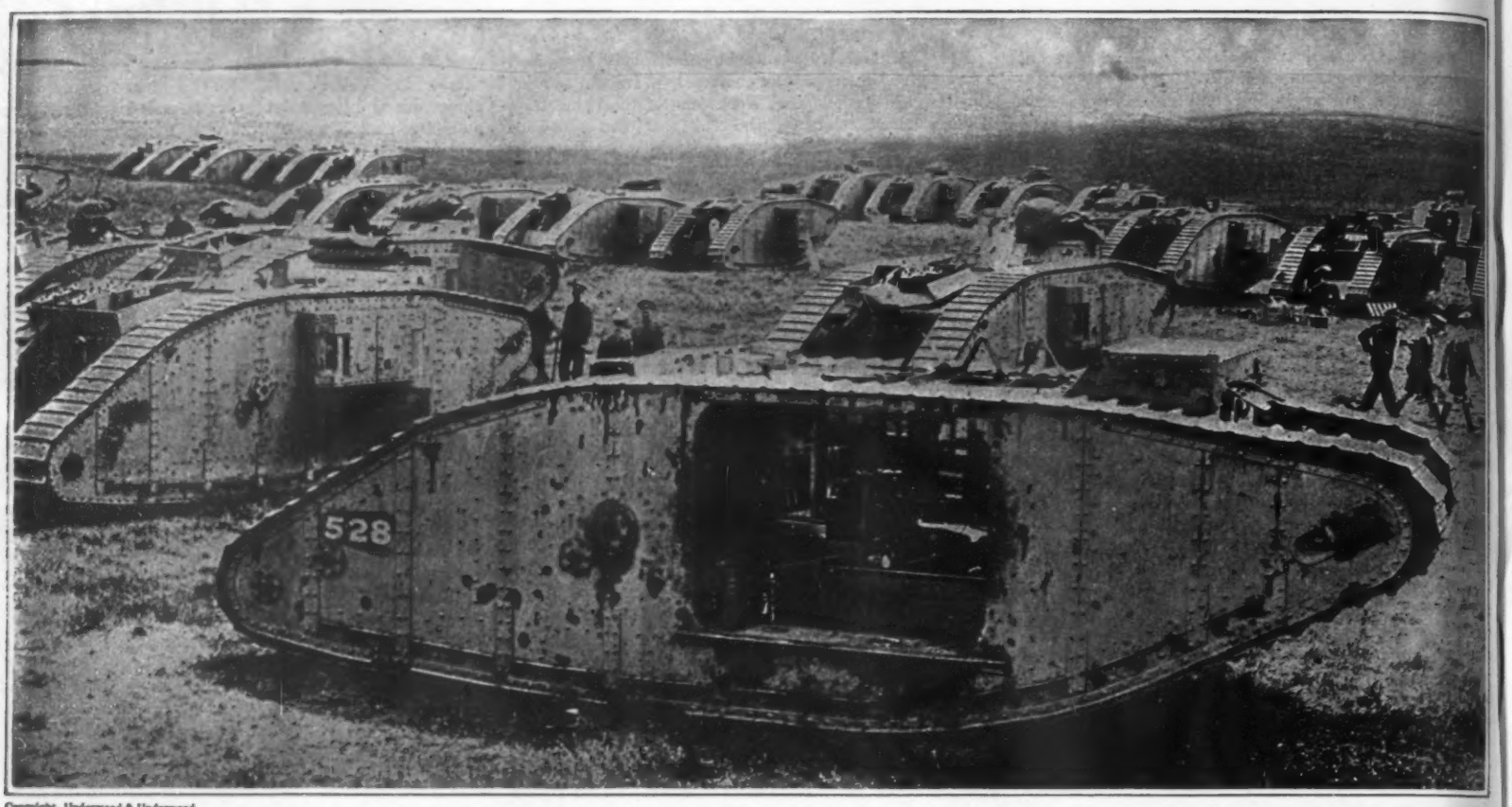
German Airplane with Five Motors.—There was recently brought down behind the British lines a German biplane of large dimensions, equipped with five engines. This machine, which is a night bombing plane, is the first brought down equipped with five engines. Developing some 260 horse-power each, the five engines give the plane a total horse-power of 1,300. This plane is evidently one of the many Germany has constructed in anticipation of long-distance night raiding.

Aerial Activity of Late.—The longer the world war continues the greater becomes the conflict on the ground and in the air. In the latter sphere the activity has attained unbelievable proportions, as witness the recent British official statement reporting over one hundred and twenty German machines shot down in two days' fighting. The average wastage daily in aerial fighting is as great today as the wastage of a month in the early days of the war. This bit of information offers interesting opportunities to speculate on the production of German aircraft, which by now must be tremendous in order to keep pace with the constant and heavy drain. Indeed, it is an augury of what we should be able to do when our aircraft production facilities are once straightened out and under full headway.

Enmeshing Enemy Night Raiders.—It now appears quite certain that both the Germans and the French are making extensive and regular use of aerial nets to bag enemy night raiders. Some time ago the use of captive balloons and aerial steel nets was reported as being tried by the Germans, in an effort to enmesh British airmen. More recently reports have come from France, telling of the use of aerial nets at certain points which are frequently passed by the methodical German raiders. Indeed, it is even said of these nets that the German airmen, fearing nothing so much as an encounter with the slender steel web in the blackness of night, have been greatly discouraged in their work. On the other hand, a recent item in *l'Aerophile* tends to cast doubt on the efficacy of the aerial nets employed in the defense of Paris.

A Four-Engined Gotha.—A giant German airplane recently brought down in France had the following characteristics: Four engines; span, 136 feet; length over all, 66 feet 6 inches; crew, number not definitely known. The correspondent of the Havas Agency on the French front telegraphs that another giant German airplane which was brought down on June 1st in the neighborhood of Retz (south west of Soisson), carried nine passengers, including the pilot officer commanding, two observer officers and machine gunners, two specialist engineers, a second pilot in charge of the engines, and two other specialist engineers. The machine is of the most recent type of giant airplanes. Its principal characteristics are as follows: Four motor engines, each of 300 horsepower; spread of wings, about 141 feet; total length, about 92 feet; crew, nine men; weight (when empty) over nine tons; weight in flight, when fully loaded, 14½ tons; weight of bombs that can be carried, about two tons; maximum speed, 75 to 80 miles an hour; armament, four machine guns.

Stopping Our Production of Bristol Fighters.—Early last year it was decided when a demand for two-seater fighters was great, to put into production at the Curtiss plant an adaptation of the Bristol fighter, an English battleplane, fitted to a 12-cylinder Liberty motor. Recent flying tests have demonstrated that this machine is over-powered and not of military value, lacking maneuverability and not having sufficient speed for war purposes. Inasmuch as the DeHaviland 4 is in production and meets the requirements, and can be produced as fast as engines can be supplied, so that there will be no decrease in the number of planes going overseas, the Bureau of Aircraft Production is compelled to take the position that the country will best be served by discontinuing Bristol planes. Every effort is being made to put into production at the Curtiss plant the S. E. 5 and the Caproni. Both planes are well known and are not experimental in any way. The Bureau of Aircraft Production hopes to be able, in the near future, to reemploy the people who will of necessity have to be laid off under this order.



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A British tank park in the rear of the lines in France, affording some idea of the vast fleets of tanks now available for the new tactics of the Allied commanders

Tactics and Tanks

How Generalissimo Foch Has Met and Bested the Von Hutier Battering Ram

VON HUTIER, the inventor of a new method of attack against intrenched foes and until recently the hero of the hour in Germany, has met his boomerang. Successful against the British in March and in April, and against the French in the latter part of May, he had every reason to believe that the super-offensive launched on July 15th last, would split up the French army, deliver Rheims, Epernay and Chalon to the German forces, and most likely open the way to the seizure of Paris and a Teuton peace.

But the so-called peace offensive failed. On the very ground chosen for their great attack the Germans were first checked, then thrown back, and finally routed, suffering the first defeat which the German High Command has openly admitted as such. Von Hutier's fame has been short-lived indeed; and from the hero of the hour he may already be the most despised man in the Fatherland. For if the Germans had not restored the war of maneuver, through their great offensives, they might have been able to meet the increasing Allied forces much more readily in their former trench lines.

Several weeks ago there appeared in these columns a lengthy discussion of the Von Hutier method of attack, and at that time it was prophesied that the Allies would no doubt be able to withstand the next German offensive by the use of a defense in depth. As the article was being written the Germans were opening up their "peace offensive" on a 55-mile front, or from Chateau Thierry to the Argonne Forest; yet the writer then predicted that the offensive would not only be held, but that the Allies, when the proper time came, would improve on the Von Hutier tactics. That is precisely what has happened, but the stroke is many months earlier than could reasonably have been expected at that time.

The grand fiasco of the German peace offensive is by now an old story. Suffice it to say here that the Germans attacked along the Marne, about Rheims, and in the Champagne sector. In the last-mentioned theater they were opposed by General Gouraud, whose forces stood along an intrenched line already held for two years or more. By arranging a defense in depth, with light outposts and forefield centers of resistance, General Gouraud's troops caused the main German blow to expend itself on scattered troops, while the massed forces to the rear were ready to deal with such Germans as came through the machine-gun nests and the terrific artillery barrage.

Along the Marne the Germans gained some ground. But several days before the blow was dealt, the French, with American aid, had been preparing for a counterblow, anticipating the German offensive on that front. On July 18th, three days after the opening of the peace offensive, the forces of General Mangin fell on the flank of the Germans and inflicted a severe defeat. From that time onward the Germans found themselves in an ever-narrowing salient, with superior forces on all sides. After a stubborn fight they retreated to the Vesle, where they are holding at this writing.

On August 10th the British and French, with some American troops, struck out in a big offensive against the Germans facing Amiens. In four days the attack brought in some 40,000 prisoners and over 400 guns, which, added to the prisoners and booty in the Marne counter-offensive, has netted some 70,000 prisoners and 1,200 guns for the Allies. That is the boomerang which Von Hutier has created for the German army!

With the results already explained, it is of interest to study the new tactics employed by Generalissimo Foch in executing these two great attacks. The Allies have evidently taken the lessons of the Von Hutier method to heart, and, indeed, have improved on them materially. The great factor still is secrecy—the massing of large numbers of troops and equipment at the selected point, and the launching of the attack without previous notice.

Courtesy Illustrated London News

Fleet of the latest type of small French tank going up to the front

In both attacks the Germans have been more or less taken by complete surprise. Instead of many hours or days of bombardment, as was formerly the practice against highly organized defenses, the Allies launched their initial attacks with a preliminary artillery bombardment of 10 minutes or less, except on limited fronts. Behind a violent curtain of fire which rolled over the German positions, the Allied infantry advanced to the attack in company with large numbers of tanks.

Both offensives have proved the value of the tank. Ever since the beginning of this year the British and French have been busily engaged in turning out smaller and faster tanks as a result of their experience with the larger models. In several local attacks the British and French tried out the small tanks, which include the British "whippets," as they are called, carrying a crew of two men and making a speed of 12 miles an hour or better, and the "baby" tanks of the French, making about the same speed and also carrying two men.

Now the main idea of a tank is to provide a mobile machine-gun battery or a mobile field gun, which can be employed to attack enemy machine guns and bodies of infantry. The armor of all tanks is of sufficient strength to resist machine-gun bullets and shell splinters, but it is vulnerable to artillery fire. If enemy artillery fire can be directed on a tank the latter stands but little chance of coming through. To a great extent the tank must conceal itself with camouflage or in mists just as long as hostile artillery is in position to deal with it.

Understanding these facts thoroughly, it appears that the Allies have gone to smaller tanks which are more mobile and more difficult to see from the enemy lines. The big tanks employed in the battles of last year were slow-moving and awkward, and it often happened that they were unable to keep up with infantry waves during an assault. But with the introduction of smaller, faster tanks, the British and French have succeeded in establishing better coöperation or liaison between tanks and infantry, as evinced in the Marne and Somme offensives. And after all, the tanks alone are of little value if they are not supported by infantry.

In both offensives the Allied infantry went "over the top" in company with large numbers of small tanks which cleared the way through the German barbed wire and engaged the machine-gun nests as soon as they began firing. The German artillery was reached and disorganized before it could counter the tanks. When the German forces broke and started their retreat, the fast tanks assumed the rôle of armored cavalry, chugging full speed after the fleeing units and hampering their transport system as much as possible. With a gait of better than twelve miles an hour, the small tanks had no trouble in keeping up with fleeing German infantrymen.

Heretofore the main difficulty in a large-scale offensive has been the bringing up of artillery to support the advancing infantry. Von Hutier employed for that purpose light guns, particularly large numbers of trench mortars on wheels; but the Allies have seen fit to improve on this method, using tanks instead. Thus the large tanks of the "male" type carrying rapid-fire cannon, and the tanks of the "female" type carrying machines guns only, have supported the infantry groups far into enemy-held ground, while small tanks have coöperated with cavalry detachments harassed by machine-gun fire.

Thanks to the tank, which is now available in large numbers, the Allies have been able to improve on the Von Hutier method of attack. This weapon has done away with the intense bombardment that was formerly necessary to account for German machine-gun nests. Thus an attack can be launched without warning, yet the hostile machine guns are not granted an opportunity of mowing down the infantry waves; a lesser concentration of artillery is possible; and such artillery as is not required for the barrage curtain, and that includes the

heavier pieces, is turned to account for counter-battery work. Finally, the bombardment of enemy railroad centers, munition depots, and cross-roads is carried out by fleets of bombing planes by day and by night, instead of by long-range guns. Tens of tons of explosives are dropped on the back areas of the enemy front—with telling results, to be sure, because every bomb is aimed at a target previously reported by fast scouts.

Meanwhile the Germans have shown their usual lavishness with machine guns. In both offensives the Allied forces have been faced by tens of thousands of machine guns: every ruin, shell hole, and even tree has sheltered a machine gun manned by picked and desperate gunners forming a rear guard. Some of these miniature fortresses have been difficult to overcome, for the reason that the Germans, shooting with cross fires, could bar further progress until the gunners were discovered and accounted for.

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A speedy "whippet" tank receiving a scrubbing

Tanks, of course, are the best machine-gun destroyers. But when tanks are not available the machine guns are accounted for by rifle grenadiers with their long-range missiles, sharpshooters, and automatic riflemen. The reducing of machine-gun nests often takes on the nature of a small battle. Infantrymen equipped with machine rifles or Lewis guns, play a stream of lead on the German gunners so as to distract their attention from other bodies of men who make their way toward the nest and finally rush it.

The wide employment of machine guns by the Germans has also led to the introduction of the French 37-mm. quick-firer, which is a diminutive artillery piece firing a 1½-inch shell. When in action the gun is manned by four men, two acting as observers and two for setting, loading, and firing. Light in weight and setting quite close to the ground, the 37-mm. cannon can be carrried by skirmishers and employed against German machine-gun nests. For this work it is said to be as effective as the tank, and large numbers are now in use in the Allied armies. In fact, the same piece is excellent against such German tanks as have made their appearance on the battlefield, the 1½-inch high-explosive shell readily penetrating the armor and causing great havoc within.

Superiority in tank equipment and tank experience has given the Allies a marked advantage which the Germans are finding it hard to meet. By applying on a larger and improved scale the surprise tactics introduced by General Byng in the Battle of Cambrai last November, the British and French and American armies have outfought the German army. In the short span of two months the enemy finds himself converted from powerful attacker to hard-pressed defender. Now he is standing on open ground, facing vast fleets of tanks which may have many surprises still in store for an expectant world.

When an Airman's Life Is Worth No More Than His Parachute

WHEN a captive balloon is set afire by an enemy airman or breaks aways from its moorings, the only chance the observers have of escaping death or capture is to jump out and depend on their parachutes bringing them gently flown to earth. It is then that an airman's life is worth no more than his parachute.

Because it shows something of the mechanics of the parachutes now employed by balloon crews, the accompanying group of pictures commands passing attention. It will be noted that each member of a balloon crew is provided with a parachute which, when folded up, is contained in a cone-shaped cover and slung over the side of the basket. The balloonist wears a simple harness of canvas tape passing about his legs, waist and shoulders, which is connected to the folded parachute by a number of stanch, converging ropes.

Great care is taken by the balloon mechanics in folding up the parachutes and placing them in their covers. In fact, the work is almost invariably performed under the supervision of the airman who is to "wear" the parachute. The large expanse of fabric is carefully folded, and together with its connecting ropes is placed in the cone-shaped container. When threatened with danger the observer climbs over the side of the basket and jumps into space, pulling the parachute out of its container. For the first hundred feet or more he drops like a stone, and then the parachute unfolds and the speed of descent is reduced to within the limits of comparative safety. It is entirely a question of whether the parachute will open properly or not; and that is why such great pains are taken in folding it on the ground. It seems that similar parachutes will soon be available for aviators.

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A revived craft: Expert armorer at work on the problem of adapting ancient body armor to present needs

Adapting Ancient Armor to the Needs of Modern Warfare

ARMOR is now being developed for the use of our soldiers. Helmets, shields, and breastplates are being evolved along the lines suggested by the armorers of by-gone ages, with the designs modified to conform with the present state of warfare and our improved technical knowledge. The research work is progressing rapidly, and our boys are shortly to be as well protected against bullets and shell splinters and shrapnel as is possible today.

The war in Europe, which has brought back into use many discarded weapons and practices of medieval warfare, has found use for armor as well. This is shown in the adoption of steel helmets by all the warring powers; in the use of heavy breastplates by the Germans and lighter breastplates for attack by the British; in the armored waistcoats used by the Italians, and in trench shields which all armies are using. Because of this revival of body armor it has become desirable to review the entire study of ancient armor, to which for centuries some of the greatest artists and scientists gave their best efforts. To such masters of the science of armor design as Leonardo, Guilio Romano, Cellini, Holbein, Duerer, Michael Angelo, and others are ordnance experts of today turning for guidance and inspiration. In fact, it can be stated that so completely were armored defenses studied in the past that today there is scarcely a technical feature brought forward that was not worked out in elaborate detail by the old-time armor makers.

Fortunately for the Ordnance Department, one of the greatest collections of ancient armor in the world, accessible to study by the American armor designers, is in the Metropolitan Museum of Art in New York city. This collection, ranking probably seventh in the world, now includes the famous Riggs collection, which represents the life work of a wealthy student of the subject and includes some of the richest and rarest pieces that have been in the market since 1850.

It was as an incident to this collection that there was established at the museum an armorers' workshop. So far as it is known, it is unique. It was established

(Concluded on page 158)

Attaching the "harness" to the packed parachute shown at left

First step in folding a parachute, preparatory to placing it in cone-shaped container

Folding operation approaching end, with observer supervising

Preparing the parachute for the balloon observers at one of the British captive-balloon parks

A Plea for Intensification of Management

Importance of a Community of Interest Between the Manager and the Men

By Mark M. Jones, Supervisor of Personnel of the Thomas A. Edison Industries

UPON financial leadership usually rests our hope for a quick readjustment of agencies of production and distribution during days of pressure. As power is usually associated with control of finances the quality of our financial leadership will be carefully tested as we shift back from war production to peace-time production, just as it was during the days of the shift from a peace to a war basis.

Up to the present time those responsible for the financial support of an enterprise have only in a limited way extended their influence into the policies and ideals of their interests. They have given but little attention to the actual balancing of responsibilities, and focusing of authority in the enterprise. They have made but limited study of the types of organization which might be utilized for their particular purpose, and have been satisfied with balance sheet results. Confidence has rested in the individual manager, and as a general practice they have religiously followed the "let him alone" policy. Such questions as follow have frequently been heard during recent months with regard to particular enterprises:

"What type of organization have they?"

"What is the main peculiarity in their type of organization?"

"Are they organized to respond quickly to new influences?"

"Have they an open-minded staff?"

"Have they a well equipped plant?"

The essence of all these questions is: "Is the enterprise balanced?" In other words, do the leaders in it appreciate that production and distribution are mainly problems in balancing, and are they acting accordingly?

The Executive's Bias

That the majority of enterprises are not balanced will be admitted by almost anyone conversant with conditions. If the executive head receives his training in the sales end of the business, he usually emphasizes the selling end and subordinates all other phases of the business to his mania for selling.

If he has been the purchasing agent, he emphasizes purchasing, and subordinates all other phases of the business to that one thing. If he has been a development engineer, he concentrates on that phase of his business, and so on, with the result that instances of proper balance are few and far between. The balancing problem is ever with us. We have it in our daily lives, at home, at work and at play. In industry, however, it is becoming one of increasing importance as the size of individual units increases.

Is the financial leadership behind our enterprises to be satisfied to leave questions of this nature entirely to the individual chosen as the executive head? Or will it inquire further and see that the enterprise is organized to apply the main principles of a code of national ideals and to hold strictly to the ethics of the particular class of business.

If financial leadership in the United States will become more keenly interested in these actual problems of manangement, and insist upon the application of certain fundamental principles of common sense, we can expect to emerge from our wartime activities into a field of business activity that is much less befogged and through which progress will be much more rapid.

My plea is for intensification of management. For an attitude on the part of the man who puts up the money that causes him to not only be satisfied with the results obtained, but to insist upon knowing how they were obtained. For an attitude that insists upon a large enough generator of energy to insure the transmission of the ideals of the industry at a high current strength into the uttermost points of authority in the organization. For a transmission system that takes the policy at the generating point and equally distributes it with a minimum loss in transmission.

If the individual or the enterprise giving energy to money by putting it to use will organize so to intensify supervision, we will approach an era of human understanding in which we may be more than in a position to meet any international competition which may develop.

The Five "M's"

The different phases of production and distribution group themselves around five "M's"—Men, Money, Material, Methods and Machines. Industries have grown up around a management which has emphasized these "M's" in varying degrees, and usually failed to balance them. The opportunities for constructive direction and control along the lines of one "M" alone—"Men"—afford opportunities for leadership that should challenge the genius of any financial power.

Are we to continue to be satisfied by purchasing the securities, clipping the coupons and depositing the proceeds or will we go further and inquire "how" and "why."

Scientific management ought to be viewed as "doing something the way it ought to be done." It should stand for balanced administration. In actually following out its principles we have analyzed and classified the more tangible of the industrial "M's" referred to above. Intensification of management, so far as it has applied to money, methods, materials and machines has been a process of analyzing and classifying that has brought great results and established the United States as the leading industrial nation of the world. Is it not time then, if we are using money, methods, materials and machines more scientifically and managing them more sensibly, to extend our energies further and take the other "M"—"Men"—applying the same experimentation, analysis, classification, etc., to it. Will the results not more than justify our action? It seems reasonable to suppose so.

If we do it, and we will, who is to stand sponsor for it; management or financial leadership?

Financial leadership must pay the price for it, and if it will at the same time stand sponsor for the movement and promote it uniformly, no greater single step can be taken for an improvement in the relations between capital and labor in these United States.

NEVER were men in so great a demand as they are today. Millions of them are needed to fight the cause of Democracy. They have been taken from all walks of life, leaving a serious labor shortage in the home land, which has been further intensified by the stupendous industrial demands of war. Their places are filled only by impressing women into service that they never undertook before. This has introduced new problems into the labor situation. The proper handling of men is a question that has received insufficient attention in the past. Today, more than ever before, it demands serious consideration. Our financial leaders have not been sufficiently interested in problems of management. There are so many managers who do not know how to handle men. The subject is one of the utmost importance, as is clearly shown in the present article. Mr. Jones is a man who has risen from the ranks. He knows men. He started out as a car conductor in Waterloo, Ia.; now he is supervisor of personnel of a group of industries employing 15,000 men and women. His plea for intensification of management must be heeded by manufacturers and financial leaders of today.—EDITOR.

Managers Without Interest in the Business

We are living in times when ownership and management are more and more widely separated. This of course exists in varying degrees at the present time, but we are increasing our aggregations of capital, and depending more and more upon managers without interest in the business to get results.

We are also living in a day when management has been little emphasized, and when the opportunities for education simply for management as a life work are limited.

Human relations finally determine the extent to which you cash in on a given amount of money invested in materials, methods and machines. You provide your manager with the most modern equipment in every respect except human, and leave him to carry into effect ideals which he may have developed himself, and which may be complete or incomplete, depending upon the extent of his experience and his individual capacity. You expect results. To secure them greater care must be taken to make certain that the right type of man is placed in the position of responsibility and at the right time. To expect results is not enough. What kind of results do you expect; temporary or enduring, superficial or constructive?

The age of small aggregations of capital was productive of a large crop of autocratic rulers or managers, men who are not autocratic in the extreme, but only in comparison with new standards formulated in the light of changing conditions.

To secure a proper and complete esprit de corps, we must see that more of the salesmanship spirit enthuses management. A democratic government derives its just powers from the consent of the governed. Our consideration for others must be greater than ever before, as in this particular stage of our development, no man is sufficient unto himself. We must therefore see that our enterprises have departments specializing on problems of human relations.

The sub-division of functions and operations in industry has become so great that our next problem in balancing our industrial development is that of human relations.

The Manager Who Knows His Men

One of the main problems in strengthening the industrial fabric of the United States is that of restoring the relationship between management and men that existed when industrial units were small and the manager knew all the joys and sorrows of each individual working for him. It of course may be out of the question to expect that the exact condition of acquaintanceship between the management and all of the men will be accomplished in fact, but it can be accomplished in effect. Through intensive organization can we not see that scientific methods are set up whereby the same intelligence is applied to transactions involving men as to all others?

We have been satisfied with conditions surrounding "Men" that we would have never tolerated on more tangible phases of production, such as money, methods, materials and machines.

We may have the best equipped factory in the world, unlimited financial resources, methods produced by the finest engineers and yet if we do not have "men" who have the "will to serve" all the other assets are of little value. Special emphasis should particularly be placed upon "will to serve," as the national efficiency today is low, and principally on account of the lack of a "will to serve:" not lack of "will to serve" the nation, but national ideals which call for doing well what is worth doing. More patience must be shown and more time spent in pointing out to men reasons why things are done. They must know more about the principles underlying decisions and regulations. They cannot be simply told "Yes" or "No" and thrust aside. The extent to which financial leadership insists upon organization for this from management will measure the speed of the improvement in industry that must come if we are to achieve the national efficiency worthy of so great a nation.

Beating vs. Playing the Game

So far as "will to serve" is concerned, we have been accused of being far behind the average European nation. The joy of "a deed well done" is rather infrequent and almost a rarity. We have demanded so much speed that we have sacrificed accuracy and have been on a quantity rather than quality basis. If we are to throw off the reputation of "dollar-chaser" we must stimulate the will to produce for the joy of producing and not subjugate the means to the end. We must have more of the spirit of "play the game" than "beat the game." Individual responsibility must be extended into the rank and file of the nation, and only by the finest kind of leadership can it be done.

If investing forces will then make a study of the types of organizations producing the best results under given conditions, they will take an important constructive step towards securing the improved conditions. Existing organizations can not be studied without revealing the lack of provision for proper administration of human relations.

Human relations determine the extent of realization upon an investment, and financial leadership determines the nature of the opportunity for the application of human energy. If investors therefore are not satisfied simply to have the results, but go further and insist upon having the result in a given way, a new era in management will be upon us.

You then who stand for or mold leadership will go one more step in advance if you will think, act and spread the following three ideas:

1. Develop "the will to serve" industrially.
2. Show that "what is worth doing is worth doing well."
3. Persuade men to "play the game" versus "beat the game."

Such action on the part of a large number of investors will do much toward bringing about that "super-organization" of business upon which we must rely for still greater national, spiritual and financial prosperity.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Wireless-Plane

To the Editor of the SCIENTIFIC AMERICAN:

It was with amusement that I read an article in the June 1st issue under the correspondence column written by Chas. Lowater.

If it is possible I wish you would ascertain from him the brand he smokes as I would enjoy such a dream myself.

If the man has had any experience in electrical or radio work he ought to realize how absurd it is to make such statements as propelling airplanes by wireless. If he had confined his statements to controlling or directing the course or speed he would have been within reason but if he expects to live to see the other he is due for a ripe old age.

RALPH W. WILEY.

San Francisco.

Direct Production of Electricity

To the Editor of the SCIENTIFIC AMERICAN:

Ten or twelve years ago we heard a good deal about the tremendous saving in fuel that would be effected by the direct production of electricity from coal or other fuel. At this time, Mr. Edison was quoted as saying, that within 10 years at most, the power plants with their expensive and complicated machinery would be obsolete. However, as this is not the case, and as there has been a lot of experimental work done, an article in your magazine summing up the most promising ideas would be most interesting to your readers, and specially us engineers and firemen of this coal district. There are quite a number of our class that have a fairly good electrical and chemical training, and owing to the growing scarcity of fuel a good deal of experimental work is being done, which may produce important results. What is most needed, however, to push this work along, is some office or bureau devoted solely to fuel saving devices, to which ideas could be confidentially submitted for criticism to scientific experts, and where assistance, financial and otherwise, would be given to promising ideas. I know men who can ill afford it, that are working on ideas, which although they look promising have been previously thoroughly tried out, and found to be impracticable. Again there are men who are working secretly, throwing away time and money, in the hope of some day getting a valuable patent. This is certainly not a subject for patents, it is a vital necessity which demands an early solution, at the same time suitable financial recognition should be given to successful ideas. As Stephenson largely solved the problem of steam locomotion by turning the exhaust up the flue so may this problem be solved, not by the complex ideas of some scientist or college professor, but rather by a comparatively simple idea of some practical working man.

AN ANTHRACITE FIREMAN.

Kingston, Pa.

Successful Experiment in Smoke Consumption

To the Editor of the SCIENTIFIC AMERICAN:

Noting from time to time the different articles in your interesting publication concerning the smoke problem, both on land and sea, and the various methods suggested for the elimination of this nuisance, I am prompted to write you concerning an experiment of mine which proved highly successful, even though it was conducted on a limited scale.

Smoke, as we all know, is the direct result of insufficient combustion, and insufficient combustion is necessarily a waste of fuel; so our purpose in dealing with this problem is two-fold: first the elimination of the smoke nuisance, and secondly, the saving of fuel.

As evidence that smoke is the result of insufficient combustion we have only to consider the "lamp and chimney" principle to prove our theory. Light an ordinary lamp and leave off the chimney and we have a red smoky flame, but the instant we place the chimney over the burner a white smokeless flame results. The reason for this, of course, is that the chimney causes a draught which draws free air up through the flame and consumes all particles of soot and smoke.

With the above principle in mind I concluded to experiment with a large stationary boiler. The boiler in question was a 50 horse-power using about six-foot length grates. I placed a row of three-inch pipe, cut in about three-foot lengths and placed along the bridge wall, side by side, in such a manner that one end terminated at the crest of the bridge wall while the lower ends extended below and immediately under the grates. The idea was to admit free air, which was drawn in under the grates and emitted along the entire crest of the bridge wall. The results were astonishing. Not only was the boiler easier to fire, but after it had been fired up for a sufficient length of time for everything to become sufficiently hot, not a particle of smoke was ever visible except when the furnace doors were opened for stoking. On examining the flues after a long run, not a particle of soot was found in them but instead a very fine coat of white ashes covered them which was easily blown out with an ordinary steam blower.

The writer is not sufficiently acquainted with the design or the method of stoking the large furnaces to state positively that this principle could be applied with equal results in the larger furnaces but in my opinion the plan is not wholly devoid of possibilities and I am quite certain that it "does the trick" in the smaller stationary furnaces.

GEO. W. WILLIAMS.

Temple, Texas.

Airplane Facts and Fallacies

To the Editor of THE SCIENTIFIC AMERICAN:

As flyers in training on scout machines for acrobatic flying at the Marine Flying Field in Miami, I and my friends have been greatly interested and slightly amused by the naive article you published in the correspondence section of your issue of May 11th, under the title of "The Nose Spin" and over the signature of George W. Williams.

This estimable gentleman has doubtless been shocked and pained by watching numerous "crashes" from the window of his apartment overlooking some flying field in Texas, and has been greatly concerned to note that none of the admirable suggestions published in your magazine for attaching parachutes to airplanes and so forth have been developed by our government, and has endeavored to reach our flyers for whose safety his concern is so evident through the medium of your magazine.

Although I cannot admit the necessity or efficacy of reversing the motor or changing the pitch of the propeller in order to come out of a nose spin, I cannot help seeing advantages in the remedies he suggests. For instance how convenient it would be simply to reverse your motor and back down into the field in case your motor should start to miss while making a "get away!" And the convenience would be enormous when it came to taxi-ing a machine into a hangar. I can visualize some thirty or forty monster biplanes slowly revolving in front of their hangars on some great aviation field, and backing into their shelters under their own power. I regret he has not outlined his idea more fully. How would Mr. Williams reverse the motor? By placing sliding gears and a clutch between the motor and propeller? Or could he have considered mounting the motor and propeller on a pivot in the engine section so that the pilot might revolve them through a half circle and have the propeller push the machine backward? I think the latter plan would be the simplest and most practical. For changing the pitch of the propeller I can think of nothing more practical than to have a system of little tin vanes hinged upon the wooden faces of the propeller and operated by a series of rods and gears running through the body of the propeller up the engine crank shaft to the pilot's seat. The attachment would resemble old fashioned window shutters in structure.

I entirely concur in Mr. Williams' lamentation of the manner in which newspaper reporters garble news from the flying fields through their lack of technical knowledge, such as calling "nose spins" "nose dives," and so forth. It is unfortunate what a number of people there are who presume themselves authorities, "military experts" and the like who make false statements in our newspapers and periodicals based on a little hearsay. However, despite the extensive acquaintance with aeronautical affairs which Mr. Williams betrays by the use of such terms as "propeller pitch," "nose dive," etc., I, because of the slight advantage I possess over Mr. Williams through a practical connection with aeronautics, must beg leave to correct a few slight errors in the information of which he is possessed. I may state with some slight authority that contrary to Mr. Williams' assertion that a "nose spin" is always fatal, it is not dangerous unless executed at an extremely low altitude, say one hundred feet, and then only because the pilot has not time in which to make effective use of his controls and bring the machine out of the spin before striking the earth. Mr. Williams has stated that spins occur in one direction only, that is contrary to the motion of the propeller, and seeks to provide a method of getting out of a spin by reversing the propeller. Not only do spins occur with equal ease in either direction, but switching on the motor in a spin in either direction only serves to make the machine spin faster and in some machines with motors turning to the right, this result is more marked in a right spin than in a left. That is the method Mr. Williams would use; it would accelerate the spin more than the circumstance Mr. Williams accuses of being responsible for the spin. To recapitulate, Mr. Williams is mistaken in believing an airplane to be an unreliable, tricky machine which may at any time go into a spin from which the efforts of the flyer to extricate himself will be useless. Considering the fact that the popular prejudice against airplanes must vanish before they will be of much use commercially, I consider it unfortunate that magazines such as yours should publish fallacies like Mr. Williams' without refutation and should in that manner encourage popular superstition.

HAZEN PRATT, Ensign, U. S. N. R. F. C.

Flying Field, Miami, Fla.

Parachutes for Airplanes

To the Editor of THE SCIENTIFIC AMERICAN:

Balloon observers are equipped with parachutes for emergencies, and it seems a very unpatriotic omission to leave them from the aviator's equipment. The value of a trained aviator for military purposes is considerable, because of the cost of the training received and of his services.

The two usual occurrences which fatally finish a flight are, that the airplane is shot down out of control, or falls because of defective parts in its construction. In either case, the aviator has no chance to escape, but with a parachute to depend on, he would, through using it in such an emergency, still be able to render the valuable services for which he was trained, the only loss being the machine.

It may be that the aviators would regard parachutes with contempt, or be prompted by pride to regard them as cowardly to use. Still, safety devices are used on shipboard and wherever else it is necessary to use them, the patriotism of their adaptation to airplanes being centered in the fact that, if the airplane is lost, the man can yet do damage to the enemy when furnished with a new machine.

Another objection which may arise is that the aviator might use the parachute and let a perfectly good airplane be wrecked. This would be due to indecision or lack of confidence on the part of the aviator; but that sort of man does not have such faults of character, and it is perfectly obvious that he knows when his machine is out of control.

Why not use a little more common sense and do this for the greater protection of the eyes of our Army?

Buffalo, N. Y. C. W.

Toothless Saws in the 'Eighties

To the Editor of THE SCIENTIFIC AMERICAN:

Some months ago you had an article regarding the cutting of metal by saws without teeth in which you gave credit to the discovery of same by someone in Germany and of recent origin.

You have already acknowledged that this was an error, but the article still continues to be republished in other journals.

I therefore suggest that you give this matter still wider publicity as it is really an old process. The writer knows positively that the saws were used in safe-making at Cincinnati, Ohio, as early as 1884 and probably for some years before that. The saws were used for cutting the heavy bolts that are used on safe and vault doors. The saws are about 30 to 40 inches in diameter as nearly as I can remember.

Since then hundreds of these saws have been used and are being used, driven by electric motors to which the saws are directly attached. The speed of the motors is about 3,600 revolutions per minute.

C. H. ROTH.

Chicago.

Emergency Repairs to an Armored Transport

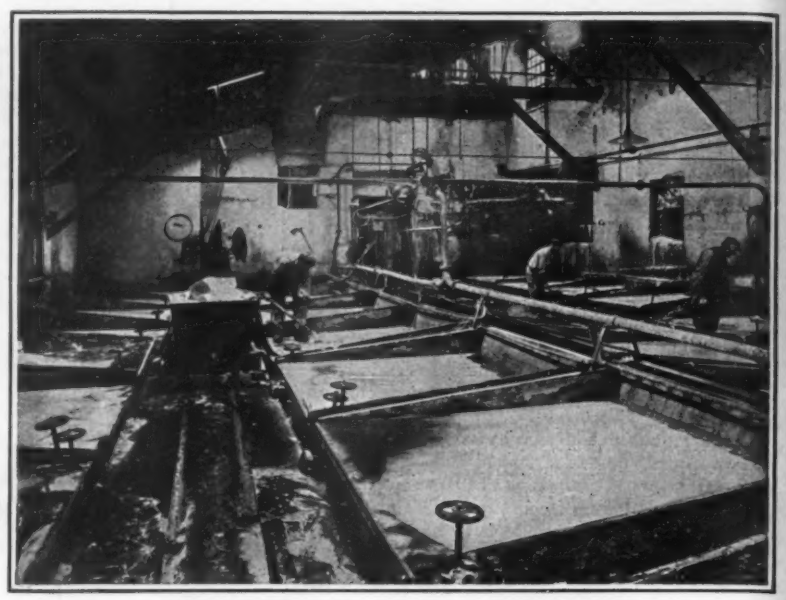
ONE of our armored transports, the "Dix," while on a voyage between San Francisco and the Philippine Islands, and when about four days out from Honolulu, had the misfortune to break her stern bearing and lose her propeller. A wireless message was sent to Honolulu, and a relief ship set out from that port and brought her back for repairs. The only possible facilities at the port were the floating drydock which was used in making emergency repairs on the Japanese cruiser "Azuma," an account of which appeared in the SCIENTIFIC AMERICAN of October 13th, 1917.

On this occasion, as on that, the ship was too large for the dock, which measures 300 feet over all, the "Dix" being considerably over 400 feet long. Manifestly it was impossible for a dock displacing 4,500 tons to lift a ship weighing over twice as much. But it was not necessary to raise the whole weight. The trouble was at the stern, and if that could be lifted clear of the water the repairs could be made.

So the dock was submerged and the ship backed into it, until the stern was flush with the cantilever footbridge, as shown in our drawing. As much weight as possible was shifted towards the bow of the "Dix," which, of course, projected far beyond the opposite end of the dock, and the dock was pumped out. The result was that, the bow being water-borne, the dock had sufficient bouyancy, when empty, to lift the stern clear of the water.

A working platform was suspended from the footbridge, and first the shaft bearing, then the hub and finally the propeller blades, were put in place. Our colored cover shows the last blade being lowered into position.

Drying the vegetable pulp after it comes from the vats



Boiling down vegetable refuse to be made into flour

Camouflaged Food

Science and Invention as Displayed in the Daily Menu in France

WE have now our Liberty bread; and perhaps, although at present better off than the other warring nations, we Americans may have to come to many other food substitutes if the war lasts long enough. Be this as it may, more than twelve years ago Professor Berthelot, in Paris, prophesied a period, some ten centuries or so ahead, when the milk, eggs and flour of the world would be made in factories—when these with all other life-sustaining articles would be the products of highly developed chemical processes. It is a curious fact that this prediction is finding thus quickly a forced partial fulfillment in France today.

One would scarcely think that the flowers would contribute their mite toward war duty otherwise than by brightening the rooms of the convalescents. But in their own way the blossoms are accomplishing important things. The high price of living in Paris has thrown coffee and tea out of the average person's reach, and as the French people must have something to liven digestion and put a sweet taste in their mouths, they are falling back upon the flowers of field and forest and garden.

It used to be that only eucalyptus, orange, tilleul, cammomile and the like were thus used, and even these for medicinal purposes only. Now at the suggestion of scientific men it is the violet, rose, verbena, heliotrope, and other members of the flowery legions that are employed in making the tisane, or infusion. Formerly one went to the herb merchant for one's springtime dose; but since the war began French druggists and even the Paris street-corner venders sell dried blossoms. In many Paris homes today flowers that have decorated a room or a dinner table, instead of being thrown into the waste when they fade, are saved and dried and separated from the stem, and the petals are then packed in an air-tight jar. When perfectly dry, they are then made into tea in the usual way.

Those lucky enough to possess sugar use a little of this and a drop of milk with the floral infusion, and try very hard to persuade themselves that they like the decoction.

Other substitutes for tea and coffee suggested by scientific men and now in common use are blackberry, raspberry, strawberry and currant leaves; and school boys are now collecting these under the direction of their masters. Recently even the parings of apples and pears have been dried and used with other ingredients in place of tea. Acorns and chestnuts are also gathered most carefully, the former to be used as coffee and the latter for oil production. Even chicory, the age-old substitute for coffee, seems to be scarce and costly, and is regarded in the light of a great luxury by those who are able to purchase it.

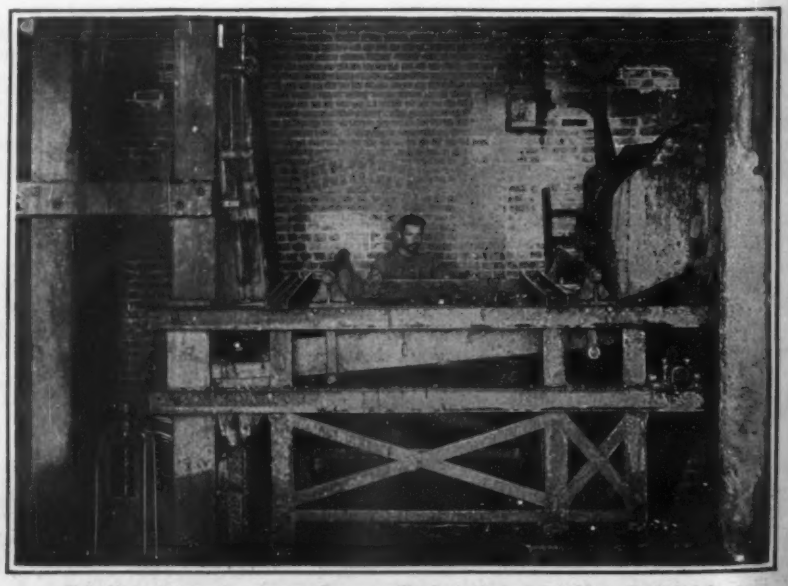
French farmer gathering leaves for use as tobacco substitute

As wheat flour is extremely scarce in France, its adulteration is being rigidly enforced. It is still possible, under certain governmental restrictions, to buy bread by the yard according to the Parisian custom, but one has only to break into it and taste it to discover that it is masquerading—it is by no means the same familiar article. Yet thanks largely to the savings we have been able to effect out of our wheatless days and other wheat restrictions, the citizens of France are not yet reduced to the extremities of Finland, where it is reported that bread is now being made with ridiculously small quantities of flour. It is a matter of record that many persons are suffering from chronic inflammation of the throat and alimentary tract because of the extraordinary quantity of straw and chaff and moss and sawdust in this bread.

In Paris a large factory was recently established for the manufacture of a substitute flour devised by a French chemist from the refuse of potatoes, turnips, radishes, parsnips and carrots. With the parings of these, saved from the kitchen waste, is mixed a certain amount of the fresh vegetables. This mixture is carefully macerated to a pulp in machines invented for the purpose, then it is mixed with the proper amount of water and boiled slowly for many hours in huge vats until the whole has been reduced to a thick soup-like liquid. A process of dehydration next removes every drop of water, leaving a perfectly dry substance, pearl gray in color and looking and tasting much like crude tapioca. As the genuine tapioca is now impossible to obtain in France, and yet, as one of the most valuable and important articles of army diet, is sorely missed, this mixture is being used as a substitute, it is said most satisfactorily. Unlike a good many substitutes, it is claimed by the army doctors to be quite nourishing and wholly harmless.

The shortage of almost every food material in France has developed an interesting search for substitutes for

The press that removes the last trace of moisture before the pulp is milled



Grinding chicory for those who can afford the luxury of this substitute for coffee—ordinarily considered a very poor one

existing substitutes. For instance, a goodly number of French chemists are trying to find something to use in place of margarine. They first experimented with soy beans, using them in the place of copra in margarine manufacture; but this was not satisfactory. Now an attempt is being made to employ a composition in which fish oil is the chief ingredient; but fish oil is pretty strong for the educated French palate, so it is doubtful that this will turn out a success.

The scarcity of tobacco in France has been felt almost as keenly as that of foodstuffs. The terms "rope" and "cabbage leaves," which we in our facetious moments have applied to inferior brands of the weed, are no longer misnomers in France; they are accurately descriptive. Some of the civilian population have been smoking wood sorrel, peppermint and yarrow. Other substitutes in use are coltsfoot, beet and plantain. Cherry, aloe, birch and nut leaves also find favor with former tobacco users among the very poor. It is little wonder that our boys, after experimenting with what the French are using for tobacco, write home such pleading letters for genuine American smokes.

Where the scientific and near-scientific food substitutes flourish in all their glory is in Paris, on the counters of the little sidewalk eating stands, where the poorest classes have been accustomed to buy for a few sous what food they could afford to keep themselves alive. The customers of these stands have no more money to spend for food than before the war—often even less. Accordingly the sidewalk merchants cannot begin to pay the wholesale prices for real food, and they have been obliged to resort to the substitutes until hardly anything they sell is what it appears to be. The customers, realizing this, have dubbed these pavement restaurants "cafes de guerre," and so doubtless they will continue to be called for many years after peace comes.

Street corner "café de guerre" at which the poor of Paris get their food

The Electrical Chicken Farm

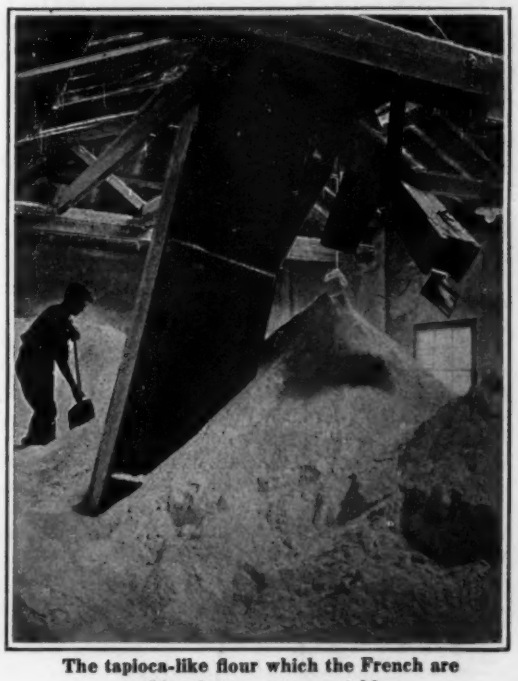
AN ingenious New Hampshire poultryman feeds his 1,500 hens with one-tenth the labor this work entails on other commercial poultry farms of similar size. He accomplishes this result with electric feed distributors, using six, each of which has a capacity of 22 bushels of mixed grain. An electric time-clock is set to operate the feeder five times a day, at which times grain is automatically scattered over 4,526 square feet of floor space. On the other poultry farms grain is scattered laboriously by hand from a pail.

"Tank" is a word which has had a very special meaning since the new engines of war were invented. On this poultry farm the word is often heard, too, but it has still another meaning. It refers to the electric self-feeders.

The giant receptacles in which the grain is stored are made of galvanized iron, and much resemble huge tops, right side up, attached to the ceiling. They hang, with the scattering mechanism, to within about a foot of the floor. When the time clock gives the word, an electric motor mounted on a short vertical shaft starts to work. The outlet in the end of the tank is opened, and as the grain drops, a swiftly revolving paddle scatters it to the far reaches of the pen. Six of these distributors operate simultaneously.

One incidental advantage of this method is that it makes frequent feeding practical, a point which the owner, who had both champion hen and champion pen at the 1917 international egg-laying contest, considers very important. "Little and often" is a principle he adheres to in feeding, whereas on most poultry farms hard grain is scattered only twice a day.

On most poultry farms feed is mixed by hand. The usual way is to dump the feed in a pile on the floor and to mix it with a shovel, then storing it in barrels or bins. But this New Hampshire farm has a better way, a way that has saved its cost several times over in the first year of use. The mixing is done in a 180-gallon hogshead mounted on a shaft placed horizontally through its head centers. A steel pulley and a 1½-horse-power electric motor complete the simple but efficient arrangement. Bran, shorts, gluten, beef scraps, and the other constituents of the mash, are dumped into the hogshead in the correct proportions, and the mixing process is completed in a jiffy. Then the grain is drawn off in drop-bottom boxes, mounted on a transfer truck, which conveys them to floor openings, through which the mash is deposited in three great self-feeding hoppers in the pen below. The hoppers hold fourteen bushels each, and the three together serve fifteen hundred hens without difficulty.

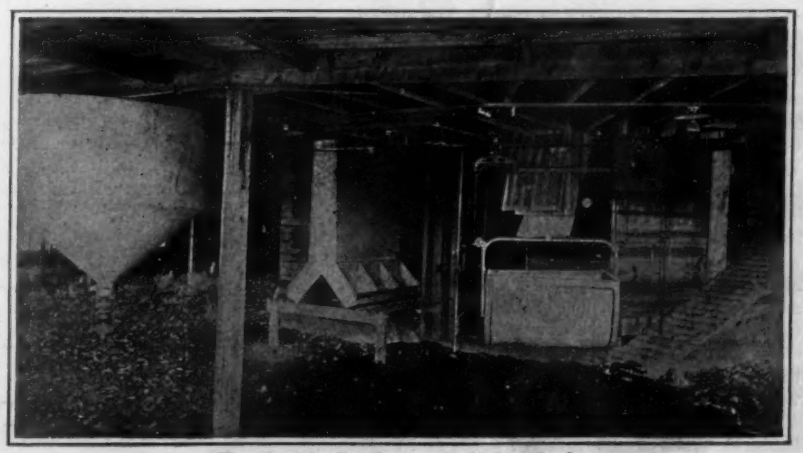


The tapioca-like flour which the French are making from waste vegetables

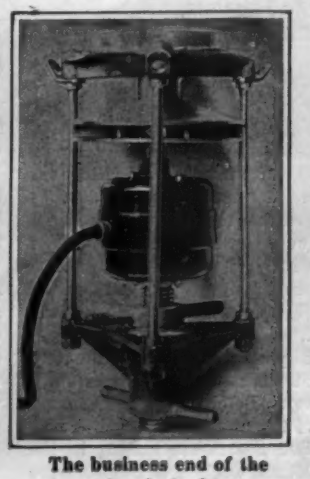
Still another ingenious device found on the farm is the electric fence which the owner put in after he had lost in a single season, from chicken thieves, skunks and foxes, 700 growing birds valued at $1,000. Using good chestnut posts he attached to the inside at the bottom ¾-inch-mesh chicken-wire, 18 inches wide. Six inches of this strip was below the ground level. Above the fine wire was a 36-inch strip of two-inch-mesh wire.

On the outside of the posts he strung three strands of wire, two of them plain, the other barbed. These were mounted on insulators, and he kept them charged with 220 volts of electrical current. Signs posted at frequent intervals announced the fact. So that he would be entirely within his legal rights, and after consultation with authorities, he set the fence line four feet inside the boundaries of his property. Thus any person coming in contact with the fence had already trespassed. The fence is nearly a mile long.

Built to last for years, this fence is rather expensive, but it has many times justified its cost. Foxes and skunks no longer catch growing chickens on range, and no thief has yet dared to tackle the electrified wires. When the weather is favorable it is unnecessary to close poultry house doors at night, which is a decided advantage, as the poultry can leave for the range at daybreak. The owner considers that for a farm such as his, in an isolated and wooded region, the electrical fence affords much better thief protection than burglar alarms, locks or dogs.



The electric distributor of chicken feed (at extreme left)



The business end of the electric feeder

The Current Supplement

COLOR has its physical and its physiological bases, but these are not in themselves color. As fact of immediate consciousness color must possess causes and conditions, and the science of color is more concerned with these conditions than with the color itself. This interesting subject is discussed in a way that will appeal to the general reader in a paper on *The Psychology of Color* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2225, August 24th. A pleasant article of a popular astronomical character is *The Lyre of the Poets*, that describes one of the small summer constellations, and is illustrated by several cuts. *The Tamarind* describes a well-known tropical tree, and the uses of its fruit, seeds and flowers. There is a photograph of a representative tree. The ocean is being looked to now as a source of food supply more closely than ever, and its resources carefully scrutinized. Studies of this kind are being pursued not only in this country, but in most other countries that border on the ocean. What is being done in Italy in this direction is told in an article on *The Oceanographic Work of the Royal Italian Commission*. Sugar rationing has proved to many one of the most irksome of our war measures, so some of our readers may derive a measure of satisfaction from the article on *Sugar Making in Cuba*, which is accompanied by a number of photographs. *How Bacteria in Milk are Counted* describes some of the methods involved in the protection of our milk supplies, a subject of timely importance at this season of the year. *The Diamond* reviews the history of the various theories and experiments that have been made in forming artificial gems, and is accompanied by a large number of drawings showing various apparatus employed. *The Alterability of Aluminum* treats of the physical properties of this important metal, and of its more important alloys under various conditions, a subject that is by no means as well understood as it should be. Other articles of interest include *Small Weights on Big Scales*, *German Airplane Design*, and *Dust Inhalation in Mines*.

One Part in a Quarter Million

IT would appear that even had the war not intervened, the platinum situation would have given cause for concern. The reason for the decline in Russian production seems hardly to have been due altogether to the distractions of war, but rather to what looks like approaching exhaustion of the better-class deposits. In the first period of platinum mining, from 1829 to 1838, the average recovery was half a troy ounce per ton of ore treated. During the next stage, 1838 to 1850, the recovery was but four-tenths of an ounce per ton; from 1850 to 1883 it averaged one-third of an ounce; and since then it has never been possible for the Russian producers to obtain a higher yield than one-tenth of an ounce for each ton of material excavated.

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Increasing Our Trading Capacity

THE addition of four billion dollars to the working capital of American merchants would give them advantages in competing for foreign trade after the war that the traders of other nations would find difficult to overcome. This sum, now estimated to be tied up in open accounts, could be released by the universal adoption of the trade acceptance in the United States. Differing from a note in that it draws no interest, a trade acceptance is an acknowledgment of indebtedness by the buyer of merchandise to the seller in which he formally agrees to pay his bill when due.

In France, where the use of acceptances is widespread, the thrift and financial stability of the small tradesmen are almost proverbial. It is the merchant with little capital who is generally lax in payment, the larger firms appreciating the value of cash discounts and being able to take them. Upon their adoption by the small business man, therefore, depends largely the value of trade acceptances in this country. In France acceptances for amounts as low as $10 are common, the French banker finding the diversification of risk derived from the discount of many small acceptances an additional safeguard.

Although the advantages of the trade acceptance seem to be recognized in the United States in both financial and commercial circles, the movement for its introduction has been carried on almost entirely by our merchants, and a member of a New York Stock Exchange house said recently that our banks could do a great deal more to help it along but for a technicality in the existing law. To be eligible for rediscount by the Federal Reserve Banks trade acceptances must bear the endorsement of a member bank, a requirement which is said to have limited the banking market for them. It has been suggested that if the law permitted the bank discounting these bills to accept the merchant's draft against them as collateral, the resulting bank acceptance could be disposed of readily in the open market and the merchant could obtain his money promptly without tying up his bank's funds.

A prominent banker has thus explained the value of the trade acceptance: "It fixes the date on which you receive your payment positiviely and it makes liquid your book accounts, which are not liquid assets. You can go to the bank on the strength of the book accounts which you show on your statement and borrow a fair amount of money if your liabilities are not too great, but it doesn't make them absolutely liquid; they are not readily convertible. But if you've got those accounts in the form of trade acceptances your bank will take the whole amount. You can realize on them right away and that is desirable for the banks because they can take them to the Federal Reserve Banks or sell them on the open market, and in that way the Federal Reserve Banks can function properly and put the commercial banks in a position where they will always be able to take care of the commercial needs of their community."

Two Good Markets for American Dyes

PRESENT conditions are favorable for extending the sale of American-made dyes in Spain, where they are needed both to replace imports formerly supplied by Germany and to help out the insufficient domestic production, hampered by the lack of benzol and coal tar. Spain's purchases of foreign dyes and colors in 1917 consisted of nearly $840,000 worth of vegetable dyeing extracts, more than $375,000 worth of indigo and cochineal, nearly $350,000 worth of coal-tar products, about $325,000 worth of mineral colors, and $150,000 worth of aniline dyes. Switzerland has captured a part of Germany's former trade in aniline and coal-tar dyes, while France and Great Britain furnished most of the mineral colors last year. Argentina and the United States are the most important sources of the vegetable dyeing extracts bought by Spain.

The Spanish cotton spinning and weaving industry, centered near Barcelona, requires considerably larger quantities of dyes than the 80 dye works in the kingdom can manufacture, and the leather and paper industries are also heavy consumers. According to a reliable authority, the quantity of American dyes and colors capable of being absorbed by the Spanish market is limited only by transportation facilities and competitive prices. In the past Paris quotations have been the principal governing factor.

With annual imports of dyes valued at approximately $500,000, Portugal offers at this time a good opportunity for American manufacturers. Before the war Germany supplied about one-half of the entire demand, but now Switzerland and the United States are leading in the Portuguese dye trade. Cotton, woollen, silk and leather factories in Portugal are prospering to an unusual degree, and in order to secure an adequate amount of dyes they are willing to meet the requirements of the American sellers. The scarcity of dyeing materials is shown by prices in Lisbon, which are now from fifteen to twenty times above normal. In Oporto, the chief market for aniline dyes, natural coloring woods are being used extensively. There is an active demand for sulfurous dyes, with direct and basic next in importance.

Harness and Saddlery Sales to Our Territories

THE increasing use of the motor vehicle throughout the world has relieved the horse of many burdens, but there is still a great deal of work for that faithful animal to do, and there are many places in which he alone can do it, resulting in a continued demand for harness and saddlery. Of the various territories of the United States, the largest consumer of these products is the Philippine Islands, where two-wheeled carriages of Spanish types and victorias drawn by small, sturdy ponies are in general use as conveyances. There were about 216,000 horses in the Philippines when the latest figures were obtained, these being well distributed through the islands of the archipelago. They are used mostly for riding and driving and comparatively little for agricultural purposes, although some are found on the plantations. Heavy hauling is done very largely by two-wheeled carabao carts, so that the demand for heavy team and truck harness is proportionately less than in some other countries.

Imports of harness from the United States, which amounted to $14,033 in the fiscal year 1917, have been limited by the fairly extensive local production, our sales of saddles and of harness-making materials being considerably more important. The chief demand is for small, stout harness for ponies, retailing at $20 to $25 per set. Because of its cheapness, web harness might find a ready market. English cut-back saddles, park, stock, leather and carpet side-saddles, and McClellan saddles are styles in greatest favor. The double cinches of the stock saddles make them particularly adaptable for use in the mountain regions. Prices in 1917 differed little from those in the United States. Saddle girths of hair, cotton and web are all imported, together with both wood and nickel-plated stirrups, riding spurs and rowels, bridles, hames, and metal ware.

Porto Rico led our insular possessions in imports of American harness and saddlery in 1917, buying $54,357 worth. This island, noted for its good roads, has been a large purchaser of motor vehicles, but that has not prevented the continued employment of horses and other draft animals for agricultural purposes, bringing about last year an increase of some $23,000 in imports of our goods over 1915. Although some carriages are made at Ponce, the population of Porto Rico will be dependent upon other markets for its manufactured goods of almost every description for many years to come.

Close behind Porto Rico in its imports from the United States in 1917 was Hawaii, to which we sent harness and saddlery valued at $53,440. The mountainous character of the islands comprising this group and the unusual area of the farms and plantations, which average about 600 acres each, makes the horse an exceedingly useful animal, and means a good market for American equipment.

In the Philippines, Porto Rico, and Hawaii the American manufacturer of harness and saddlery can sell his products free of the customs duties that his foreign competitors have to pay, but this advantage will not insure the maintenance of his trade after the war unless his prices are fair and he complies carefully with the particular wishes of his customers in these islands.

Music and Morale in British Dominions

OF Germany's exports of pianos, organs and parts in 1913, valued at $13,205,000, more than one-third were sent to the United Kingdom and its colonies, and for long after the war, there is a fine chance for the United States to capture a generous share of this trade. When the question of essentials and non-essentials arises, there is no doubt about the answer in the case of musical instruments. They are an important factor in keeping up the "win the war" spirit. Just as Australian troops sing when going into battle, so do the Australians at home find recreation in music. They are a very musical people, and are buying from us, right now, considerably more than a million dollars' worth of pianos, phonographs, and other instruments annually. In the fiscal year 1917 the United States exported 6,390 pianos to Australia, valued at $855,604, of which 824 were player pianos; 4,168 phonographs with a value of $159,965, and $101,111 worth of phonograph records and materials.

"We like pianos with a softer tone than yours have," says an Australian visitor. "Before I left Sydney, somewhat more than a year ago, a dealer there told me that he was importing from forty to fifty pianos a month from the United States. They were moderate in price, selling at $300 to $400 each. Most of the English pianos imported are very high priced. The upright is preferred, very few grand pianos being sold. In spite of the preferential duty on English instruments, there is an excellent opportunity for American manufacturers, of which they have not been slow to take advantgage. A good many phonographs are in use in Australia although until recently no energetic effort has been made to push their sale. The more expensive styles seem to sell more readily than the cheaper grades, and the horn machine is giving way to the cabinet type."

Before the war Germany had a strong hold on New Zealand's trade in musical instruments, supplying a fair product at a very reasonable price. Imports of pianos, phonographs and records have been very active during the past three years and the future is promising for American lines. There is little complaint relative to the tone and mechnical action of American pianos, but the style of the case does not appeal to the average New Zealander. The English style of cabinet is preferred and it would seem wise for American manufacturers to meet this feature as a means of increasing business. More than $40,000 worth of pianos and organs were sent from the United States to New Zealand in the fiscal year 1917, together with nearly $33,000 worth of phonographs and records. There is room for material increase in our sales, as Germany disposed of pianos valued at $190,000 in this market in 1913.

Canada takes more of our musical instruments than any other British colony. Last year our northern neighbor bought from the United States 51,471 phonographs with a total value of $1,176,650, in addition to more than $830,000 worth of records and materials. With purchases of pianos and organs amounting to some $275,000 and other musical instruments valued at $565,000, Canada's total imports of American goods of this class approached $2,000,000 in 1917. The style of piano preferred in Canada is the upright, with a plain mahogany case, about four feet, six inches high. Highly polished cases sell better than those with a dull finish. There is keen competition on account of the extensive domestic manufacture, and several Canadian branch factories are maintained by American firms to overcome the handicap of customs duties. Climatic conditions in western Canada are considered to be among the most severe in the world on musical instruments using sounding boards, which split and warp badly, the veneer of the cases breaking and the varnish becoming checked. The use of mahogany for cross-banding, with four inside veneers running lengthwise on each case, counteracts in a measure the rigor of the climate.

The effect of the war on sales of pianos in South Africa has been remarkable. Most of the dealers are selling more instruments than ever. American pianos in this market are said to be of far better quality than those coming from England, and if the freight and transport difficulties were not so great, South Africa would buy many more American instruments. The percentage of the white population owning pianos is large, most of the farmhouses and nearly all of the hotels and boarding houses having them. The favored style is the upright with the front ornamented by divided paneling, each panel generally being molded, while the center one possibly has inlaid work. Divided lifts are required, and a finish of natural walnut is preferred. In most cases the pianos are supplied with brackets for candles or lamps. No wood not thoroughly seasoned, or any other material likely to shrink, should be used in pianos sent to South Africa on account of the very dry atmosphere. In 1917 the United States shipped to British South Africa musical instruments with a total value of more than $75,000. In 1913 Germany's sales in this market amounted to $387,000, so there is room for considerable American trade extension.

In normal times Great Britain is the largest purchaser of our musical instruments. An import duty of 33⅓ per cent, imposed since the beginning of the war, has temporarily affected the chances of American manufacturers in England, where there is an active demand for cheaper grades on account of increased wages in the munition centers. In both England and Ireland second-hand pianos are commanding unprecedented prices today because local manufacture has been restricted, the wood and the wire formerly used in pianos now being required for airplanes. The outlook for American musical instruments in Great Britain and its dominions after the war is most encouraging. Germany has lost heavily in these markets and the United States should make a corresponding gain.

The Mammoth and Great Onyx Caves

Unpublished Features of Kentucky's Great Natural Curiosity

By Le Roy Jeffers, F.R.G.S., Mem. Explorers Club

TO the explorer who seeks variety of experience, one of the most fascinating lines is that of cave exploration. Throughout our western country there are many interesting caves that await discovery, and others that have been but partially explored, but no section offers a better opportunity than the limestone region of Kentucky.

Longest known and most often visited, the Mammoth Cave of Kentucky is still somewhat inconvenient of access, but it well repays the journey for all who seek acquaintance with the subterranean world. Since 1842, when Stephen L. Bishop, the first explorer of the cave, wrote his name and the year at the end of every lead which he followed, 152 miles of passageways, comprising 256 avenues, have been discovered.

Revisiting the cave in 1917, I secured the services of a descendant of the original explorer, and we set out for the most interesting and little known passageways. Here the footprints of early explorers lay undisturbed for many years, and we found several of the hollow sticks having burnt ends that were used by the Indians as torches. There is no evidence, however, that the Indians penetrated for any great distance. All the passageways of the cave are the water worn channels of former days, and Echo river still lingers, often rising with such amazing rapidity that parties which have drifted on its surface are unable to return by the same route an hour or two later. Apparently no water has recently flowed through the passageways which the Indians visited for had such been the case, a deposit of mud would be found in their hollow torch sticks. The present inhabitants of the cave are big rats whose tails leave their trails in the sand, beetles, white crickets, eyeless fish, and crabs.

Often the passageways are very narrow and winding, as in the Black Chambers, while in many of the never used smaller ones, there is barely room to wriggle forward by inches, pushing one's lamp before one. In certain sections of the cave one may find a labyrinth of passageways, in some instances five levels being one above another. I was able to explore one of these, in a distant section of the cave, which had been considered inaccessible owing to the inconvenient height of its entrance.

The Mammoth Cave is unique in the width and height of its great chambers, and in its vast pits and domes which were hollowed out by the swirling water. Some of these are between 200 and 300 feet from top to bottom, by far the finest being Cathedral Domes which are far distant from the usual routes of travel. Discovered about 65 years ago, they were lost for 50 years, being rediscovered by my guide in 1908. There are four adjoining domes probably at least 250 feet in height and 30 to 40 feet in diameter. Their walls are of fluted limestone in horizontal and vertical layers from which water is dripping. Brown and slimy with mud, they are impossible to climb unaided by ladders, so that the openings far up their sides must remain for the present unexplored, and the domes themselves terminate the cave in this direction. Instead of being very rarely visited Cathedral Domes should be accessible to any seriously minded tourist.

Copyright by L. P. E. & E. T.

The colonnade in Great Onyx Cave

Men are occasionally lost in the cave by becoming tired at the slow progress of their party, and starting off on their own account. After a little they become confused amid the multitude of passageways, wander around for hours until their lights go out, and then spend the night in darkness and fear, shouting until they are rescued. Some years ago four men left their party, and, failing to appear, my guide went after them at seven in the evening. He had already had a hard day's work in the cave, but he searched until one in the morning before he heard their calls. They had only one light left which was nearly burned out, and they were well scared. After their rescue one of them said, "This man saved our lives, I move we each give him a dollar."

Distant about three miles northeast of Mammoth Cave is the Great Onyx Cave, discovered about two years ago by its present owner, Mr. L. P. Edwards. Walking through the beautiful Kentucky forest, filled with a multitude of little birds, and Bob Whites cheerily whistling, I reached the farm house of Mr. Edwards toward evening. Practically unknown and unvisited, this cave is the finest of its type with which I am acquainted. Its known passageways take about three hours to view and are everywhere of the most surprising interest and beauty. This was a sealed cavern until its recent discovery, and its exceptional formations are uninjured by tourists or by smoke.

Entering the cavern, one passes through a chamber in which a fairy forest of stalactites and stalagmites is growing. Often they join to form a massive column 12 feet in height that seems to support the roof; again the diameter of the column is only that of a pencil. It is said that the gradual dropping of water adds the thickness of a wafer to such formations in five years. The smoother portions of the roof are plastered as if by hand with plate gypsum, white and sparkling as the purest snow in sunshine. Fringes of tiny stalactites like icicles run here and there over its surface and occasional clusters gather in rich profusion. Other ceilings closely resemble new brown maple sugar. Beyond are transparent shawl-like draperies that suggest strips of bacon when a light is placed behind them.

As we penetrate the most distant portions of the cave the gypsum formations increase in beauty and wonder and we find many varieties in active growth. Here the roof is laid with fiber gypsum, finer and softer than cotton; there the walls are covered with needle gypsum resembling angora fur, or the formation is feathery like frost flowers upon the mountains. Cauliflowers are abundant, while the ceiling is often covered

(Concluded on page 158)

Showing the size of the cave chambers

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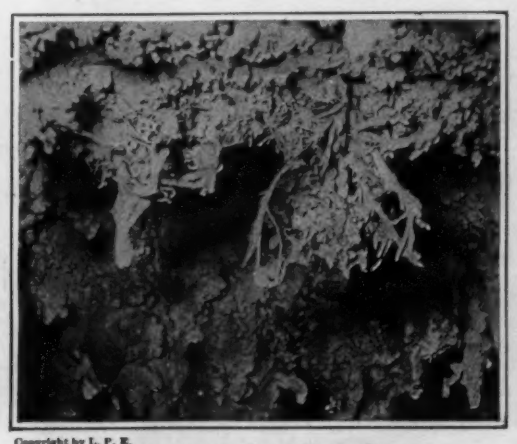
Natural "hieroglyphics" on wall of the cave



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The hanging garden of Onyx Cave

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The stalactites of Drapery Dome

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

An Improvement in Stabilized Scales

THE stabilized weighing-scale is so-called because, while having its platform above the weighing beam, it comprises a mechanism which makes it a matter of indifference whether or not the load be centrally applied. Without such an attachment, a badly centered load would exert a rotating moment on the pan and make it take a position not exactly parallel to its normal one. The stabilizer constrains the pan to motion in parallel planes and so eliminates this tendency.

In the ordinary forms familiar in the postal and packages scales of moderate capacity, the stabilizing element is a simple flat bar provided at each end with a hole through which passes a pin connecting the bar, at one end with a fixed part of the scale, at the other with the vertical stem supporting the platform. In order that the weight registered be independent of the position of the load upon the platform, the length of this link, between the centers of the pinholes, must be equal to the distance between the two knife-edges which, respectively, carry the load and provide the fulcrum.

But when this stabilizing mechanism comes into play, there is set up a friction at its pivot points. This friction is notably in excess of that at the knife-edge bearings, and it is decidedly variable. Accordingly it limits the sensitiveness of the instrument, and seriously reduces its accuracy. So F. J. Schlink, Associate Physicist of the Bureau of Standards, has set himself the task of evolving a new type of stabilizing member which shall be free from this objection; and he appears to have succeeded in his efforts.

Mr. Schlink argued that the root of the whole evil has arisen from the necessity of having the stabilizing element rigid and inflexible. It then occurred to him that if the load could be so disposed that its rotating movement would always *pull* on the link, instead of sometimes pulling and sometimes pushing, this rigidity could be dispensed with. In the ordinary type of weighing-pan, if the load is off center in one direction, it will pull on the stabilizing link, if off center in the opposite sense it will push. So the remedy has been found in an offset stem for the weighing-pan, carrying the whole configuration of that pan over in front of its supporting knife-edge, between that knife-edge and the fulcrum point. Then no matter where the load lies in the pan, its rotating influence is in the same direction. It is now possible to introduce a flexible elastic tape of metal or some other material in place of the rigid stabilizing bar, and it is obvious that this tape can be so joined at its ends, by means of screw clamps, that what under ordinary circumstances would give rise to friction, is manifest only in slight bending of the tape where it passes into the clamp, or in elastic stresses in the tape itself. The friction inherent in the journal-and-bearing type of connection is thus eliminated. Since the load can never push on the tape, the tape cannot buckle, and the thing is done; we have a scale which will weigh relatively large loads with high accuracy.

Controlling the Temperature of the Soldering Iron

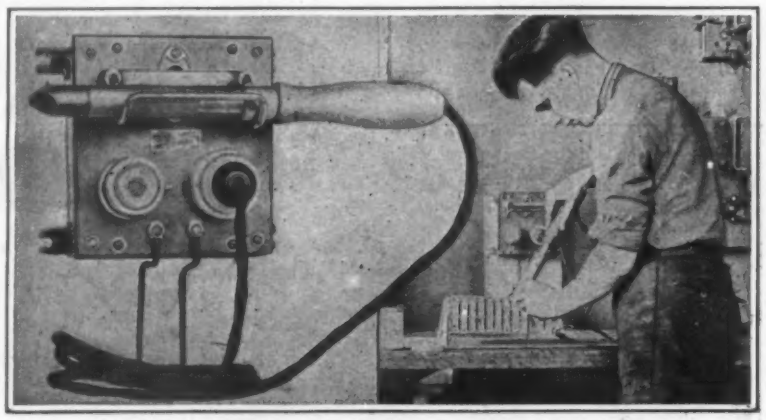
ELECTRIC soldering irons, because of their great convenience, have come into extensive use. One point of objection is raised, however, because of the trouble occasioned on some kinds of service due to burning out of the heater unit.

The reason for this will be readily understood. Heat is generated in the iron by passing electric current through the coil of the heater unit. As the iron is applied to the work heat is drawn from it into the other metal; and as long as heat is thus drawn off and used, a satisfactory working temperature is maintained.

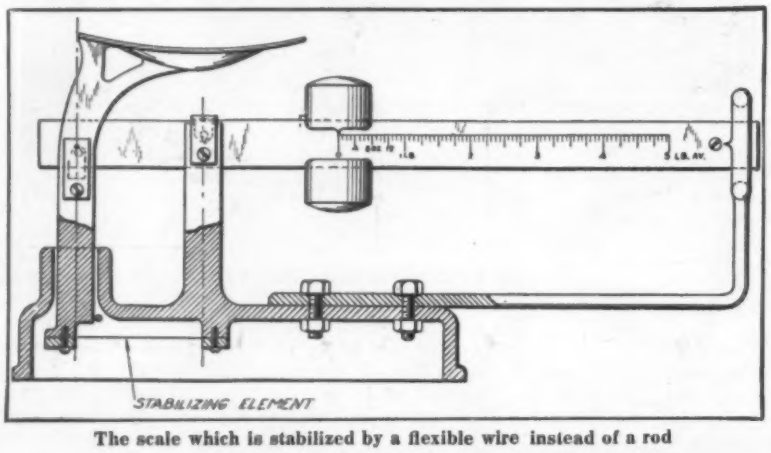
Now if the metal body on which the iron tip is applied is too light in proportion to the iron or if the iron is not applied to any work and the current remains "on," little or no heat is conducted away, with the result that the coil overheats and there is the ever present possibility of a burnout. If the current is always turned off the iron cools and time is wasted when it is again wanted.

A device has been developed which operates on the principle of the telephone receiver hook in that the weight of resting the iron on the support or hook, bears this down and inserts resistance in circuit with the iron. This reduces the current consumed when the iron is not in actual use but does not cut it out entirely; hence the iron does not become cold. When the iron is lifted from the support the resistance is automatically cut out of the soldering iron circuit and the iron gets full current and is ready for use.

The device thus provides a convenient support for resting the iron, insures against the burning out that may happen when an iron is left with current "on," and saves time by keeping the iron ready for use.



Rack cuts down the current in the iron when not in operation



The scale which is stabilized by a flexible wire instead of a rod

Components of the mess kit for soldiers and campers, with an opened can of the solidified alcohol cubes used as fuel

Mess kit ready for use and packed up for carrying, showing its practicability as well as its high degree of portability

[A Kitchen That Packs Up in the Soldier's or Camper's Kit

ON the hike, in the lifeboat, at the camp, or in the front-line trenches, it is now possible to prepare a hot meal and piping hot coffee or tea in seven minutes. One merely sets up a little stove and fills the aluminum pots and pans, and then touches a match to two fuel cubes which instantly give a hot, steady flame. Until the time of use the little kitchen equipment has been nested into a small package which readily finds room in the soldier's or camper's kit.

It was while engaged in mining out West, living the life of the camper and outdoor man, that Mr. I. Popper of New York city came face to face with the problem of providing hot food under all conditions. He gave much thought to the subject and finally evolved his present mess kit, which has met with immediate favor not only from soldiers and campers, but from anyone having need for a portable kitchen equipment. At present the mess kit has been approved by Army authorities, and the U. S. Government has ordered large numbers for the lifeboats of the Army transports.

Simplicity itself is the cardinal feature of Mr. Popper's mess kit. Completely nested, ready for carrying, it has a diameter of 6¾ inches, a height of 3⅝ inches, and a weight of 18 ounces complete with fuel for about ten meals. It consists of a frying pan or sauce-pan which serves as a cover for either boiler when inverted; an upper boiler with a capacity of 28 ounces, which absorbs heat from the lower boiler; a lower boiler with a capacity of 22 ounces, which is placed directly over the flame; a burner, part of which can also serve as a drinking cup, and the other elements of the stove proper; a combination spoon, handle and fuel-can opener; and a can of fuel containing 20 cubes. Ready for service, the triple-deck mess kit is compact, convenient, and efficient. Everything is right at hand—two boilers of generous capacity topped by a frying pan or cover. Two cubes of fuel will at one time warm to eating temperature one standard can of pork and beans, spaghetti or kindred food product; heat to high temperature one standard can of soup, vegetables or the like; and boil 16 ounces of coffee, beginning with cold water at 52 degrees, all in seven minutes.

The fuel consists of solidified alcohol in the form of cubes about an inch all around. Two cubes are employed at one time. The heat is conserved by an ingeniously devised apron, and a flame protector insures against the most industrious of gales. The fuel is always ready; even if immersed in water it can be removed and immediately ignited. It is safe to handle, burns without soot or deposit, and gives off no unpleasant or dangerous fumes. The pan and the boilers, which become hot in a short time, can be handled by means of the spoon which serves as a handle, as shown in the illustration.

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Fire Didn't Affect "85% Magnesia"

This is an actual picture of the remains of a factory fire in a New England textile-mill.

The building was entirely demolished. The boiler-house went with the rest. Even big steel beams were twisted and collapsed in the intense heat. It was, as the fire underwriters say, a "total loss."

The only thing worth salving was the Pipe-Covering.

Because this was "85% Magnesia," it had withstood both the flames and the streams of water that had been poured over it by the firemen. While, of course, the canvas covering was burned completely away, the "85% Magnesia" itself remained unharmed.

"Heat-insulation" that won't stand high steam-temperature is a fraud. That is why materials of an "organic" (animal or vegetable) nature are of little value as pipe- and boiler-coverings. "85% Magnesia" is an inert mineral mixture that is absolutely unaffected by the temperature of the highest pressure or superheat steam in ordinary practise.

While "85% Magnesia" was thus inconsumable and unharmed in this conflagration, it is not sold as a fire-resistant. Some other materials are better fitted for such work.

But as a *heat*-saver, it is without a rival, not only because of its *initial* powers of heat-resistance, but because those powers continue unimpaired for as many years as the pipe or boiler will last, and in many instances even longer.

The full story is told in "Let '85% Magnesia' Defend Your Steam," a treatise on heat-losses and heat-protection. The Standard Specification for the scientific application of "85% Magnesia," compiled and indorsed by the Mellon Institute of Industrial Research (University of Pittsburgh) and issued by the Magnesia Association, is sent upon request.

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The Mammoth and Great Onyx Caves

(*Concluded from page 155*)

with gypsum snow balls which are budding and blossoming into flowers until there seems to be a great garden above one. Elsewhere the gypsum is peeling away in wax-like plates to give place to a younger growth.

Some of the more delicate alabaster formations are of a lime-grape appearance, while others have coverings as white as snow. Possibly the most marvellous are the alabaster helectites which are a curious twisted form of the stalactite. In the limestone rock of the ceiling there are tiny tracks along which the water found its way, and its gradual dripping at slightly varying points is supposed to have formed these helectites which grow in every direction, regardless of gravitation. Great clusters of white, yellow and brown flowers and fruit hang invitingly above one, or one may fancy he sees in them many varieties of mosses and seaweeds.

So beautiful and so perfect are these formations in the Great Onyx Cave that one feels it should in some way be taken over, together with Mammoth Cave, by the Government and administered by the National Parks Service for the benefit of the Nation.

Adapting Ancient Armor to the Needs of Modern Warfare

(*Concluded from page 149*)

for the purpose of cleaning, repairing or, in rare cases, for restoring pieces that were defective. To this end that museum has studied exhaustively the processes of making armor and has collected from all parts of the world the tools of the ancient armorers' art. Included among these are about ninety kinds of anvils and "stakes," several hundred different kinds of hammers, curious shears and instruments, the very knowledge of which has today almost disappeared—almost, because there still exist armorers who have inherited the skill of their ancestors. At least six of them are known to be working today. One is in Dresden; one in Switzerland; two in Japan; one in London, and one, a French artist named Daniel Tachaux, who is now working under the supervision of Major Bashford Dean of the Ordnance Department in the armor workshop of the Metropolitan Museum of Art.

As an artist in hammer work M. Tachaux, many students believe, is superior to all. He was born in Blois, where his forebears had been doing metal work for many generations. Going to Paris in the 'seventies, he was apprenticed to the famous Klein, who was brought from the Dresden armory at the order of Napoleon III to clean and repair the armor which Napoleon was installing in the beautiful Chateau of Pierrefonds. Thus, both by training and descent, M. Tachaux represents the skill of the armorers of ancient times. Ten years ago he was brought to New York and given an appointment as assistant to Major Dean, then curator of the armor collection at the Metropolitan Museum of Art.

When the war broke out, learning that the Government was in need of skilled makers of models for the preparation of armor, Director Robinson of the Metropolitan Museum, with the sanction of the Trustees, placed the Department of Armor at the disposal of Secretary of War Baker. Since then, numerous designs have been carefully worked out by Major Dean and actually made by Tachaux and his young French assistant, Sergeant Bartel, now of the Ordnance Department.

Major Dean himself was brought into the service of the Army in November, 1917. Owing to his lifelong study of the subject, he was commissioned as a Major and sent abroad at once to report on the status of armor. He returned to the United States late in January and has kept the armor workshop of the Museum busy, week days and holidays, turning out models in accordance with the suggestions of General Pershing and the Ordnance Department. No less than twenty-five different types of armor defenses have been made in various factories in experimental lots, including in number from a few score to many thousand pieces, some of which have found favorable comment at American Headquarters. These armor defenses include even arm and leg guards, the use of which was suggested by the study of hospital statistics in France and England. It appeared that more than 40 per cent of the hospital casualties suffered were leg wounds and no less than 33 per cent arm wounds.

In connection with this work, every effort has been made to improve the character of the metal used in the armor making. A committee of the National Council of Defense, including the names of such armor experts as Alexander McMillan Welch, Edward Hubbard Litchfield, Ambrose Monnel, Dr. G. O. Brewster, and Clarence H. Mackay, has dealt especially with the problem of personal armor. And some of the most eminent metallurgists of the country, including those on the committee, have devoted almost all their time to the question. Among these is Prof. Henry M. Howe of Columbia University, who has made an exhaustive study of helmet metal, aiming to give the American soldier better protection than the soldier of any other nation.

Kinked Rails and How They Occur

A DEFECT which develops in railroad beds occasionally is the kinked rail. The phenomenon is in some way the result of the rails being damaged through incorrect counter-balancing of locomotives. An interesting instance was observed recently on a western American railroad shortly after the receipt of some new Santa Fe engines from the builders. Shortly after the engines were placed in service it was discovered that the rails were being kinked down and in toward the center of the track, and tests made to determine the conditions under which this damage occurred showed that it commenced when a speed of 50 miles per hour was reached and that it became marked when the speed rose slightly over this figure. In fact, many of the rails damaged at the higher speeds had to be removed from the track.

The damage consisted of an appreciable bend in the rail both horizontally and vertically. Sometimes the kinks were spaced at intervals equal to practically the exact circumference of the driving wheels, while in other cases they would be farther apart. In one instance measurements extending over 10 rail lengths indicated that the kinks were 7 inches farther apart than the circumference of the wheels. Sawing and calipering of the rails indicated that the rail section had not been distorted but that the entire rail was bent. There was no indication that the head had been bent on the web or that the web had been bent on the base.

This condition was called to the attention of Prof. A. N. Talbot, chairman of the committee on stresses in track of the American Railway Engineering Association, and the committee has undertaken to study the problem. While the committee is still working on it, certain tentative conclusions have been drawn. It has been found that the stress in the rail under the main driver with the counterweight up was eight times as great as that which occurred when the counter weight was down, while under the other drivers the stress had its maximum value with the counterweight at its low point. These results were found at a relatively high speed for the type of locomotive used. Mean stresses in the base of the rail were found as high as 52,000 pounds per square inch, which is equivalent to 57,000 pounds per square inch in the head of the rail for that particular rail section.

In some of the test runs, both vertical and lateral kinks were created at points removed from the instrument and measurements from the kinks to the instruments indicated that the counterweight of the main driver was at the high point over the kinks. It is stated that the main drivers on the locomotives giving rise to the trouble were not counterbalanced by more than 900 pounds, while the other drivers were over counterbalanced.

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The Right Way vs. the Wrong

IT is not always realized how greatly modern industry runs toward special materials, prepared for special use, and accordingly possessing special properties, different in one or more respects from the properties of the general class of substance in which they fall. Thus, we have a wide variety of leathers and linens and cotton fabrics got up with particular reference to their behavior under a certain set of conditions; we have innumerable special alloys for special uses, which have to be considered as belonging in the same family as steel, or brass, or aluminum, or some other familiar metal, but which differ from the other members of that family in some characteristic which is of importance in connection with the use for which they are intended.

On the very ground of this distinguishing feature, it is frequently necessary to modify, in some way, the treatment which custom prescribes under certain conditions. If we succeed in raising the melting point of a metal at the sacrifice of some of its hardness, it may well be that some of the traditional processes carried out on that metal will have to be altered in order not to have a destructive effect in view of the increased softness. The makers and marketers of the new substance will know just what the conditions are with regard to such matters; and they will prescribe certain precautions or certain special steps which must be taken in using it under the critical circumstances.

The user will not always know why these special regulations are laid down; and there is always a certain degree of temptation for him to transgress them, and treat the new material in all respects as he has been in the habit of treating the one which it is intended to replace. But so sure as he does this he is making trouble. The special instructions have not been formulated just for the fun of it; and if it is desired to reap the benefits of the new and presumably superior material, the user should be prepared to handle it in the way advised by the maker.

An excellent case in point is one which recently arose in connection with a newly marketed lead-base die-casting metal. A user stated, before a prominent technical body, that this material would oxidize very rapidly at temperatures of 700 degrees and over—temperatures to which, by the way it is regularly exposed in use. And to be sure, it does so oxidize—if the special precautions outlined by the maker to prevent that very thing are not followed. If the speaker had been willing to concede that the maker probably knew more about the new alloy than he himself did, and to pay proper attention to the directions dictated by that superior widsom, he would have been spared the pain of placing himself in an untenable position. If he was not willing to depart sufficiently from the paths of habit to comply with these instructions, he should have been content to go right on using the good old babbitt metals with which he was familiar, and forego the possible advantages of the new material.

Process for Artificial Diamonds

UP to the present time the only proved source of artificial diamonds has been iron or silver intensely heated and then cooled rapidly. Diamonds appear to be formed within the metal after it has set, probably at a temperature of about 690 degrees C. In no other way than this has it been possible to have realized the combination of high temperature and high pressure under which nature appears to have converted carbon into diamonds.

A recent lecturer has suggested a variation upon this procedure. He finds it probable that if a large mass of iron, alloyed with other elements, were submitted to suitable heat treatment, and after setting but while still at a temperature leaving it permeable to gas, were subjected to carbon monoxide at a pressure of about a thousand atmospheres for a long time segregations might take place slowly within the mass, and diamonds in paying size and quantity might be commercially produced.

Balzac—greatest of French fictionists—used to keep seven quill-wielders busy at one time. They wrote to his dictation in longhand. ❦ ❦ ❦ But the typewriter changed all that. It increased *tremendously* the power of the copyist. ❦ ❦ ❦ And just as the typewriter revolutionized old methods, so, in turn, does the *Mimeograph* multiply the power of the typewriter. It reproduces five thousand perfect duplicates of a typed or written sheet an hour—*at small cost.* And designs, sketches, plans, signatures, etc., may go on the same sheet, in the one operation. *Unexcelled* is the work of the Mimeograph now—and *needed.* Get booklet "A4" from local dealer, or A. B. Dick Company, Chicago—and New York.

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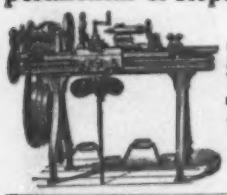

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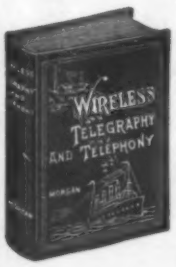

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THRIFT IN THE HOUSEHOLD. By Dora Morrell Hughes. Boston; Lothrop, Lee and Shepard Company, 1918. 8vo.; 288 pp. Price, $1.25 net.

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AQUATIC MICROSCOPY FOR BEGINNERS. By Dr. Alfred C. Stokes. New York: John Wiley and Sons, Inc., 1918. 8vo.; 334 pp.; illustrated. Price, $2.25.

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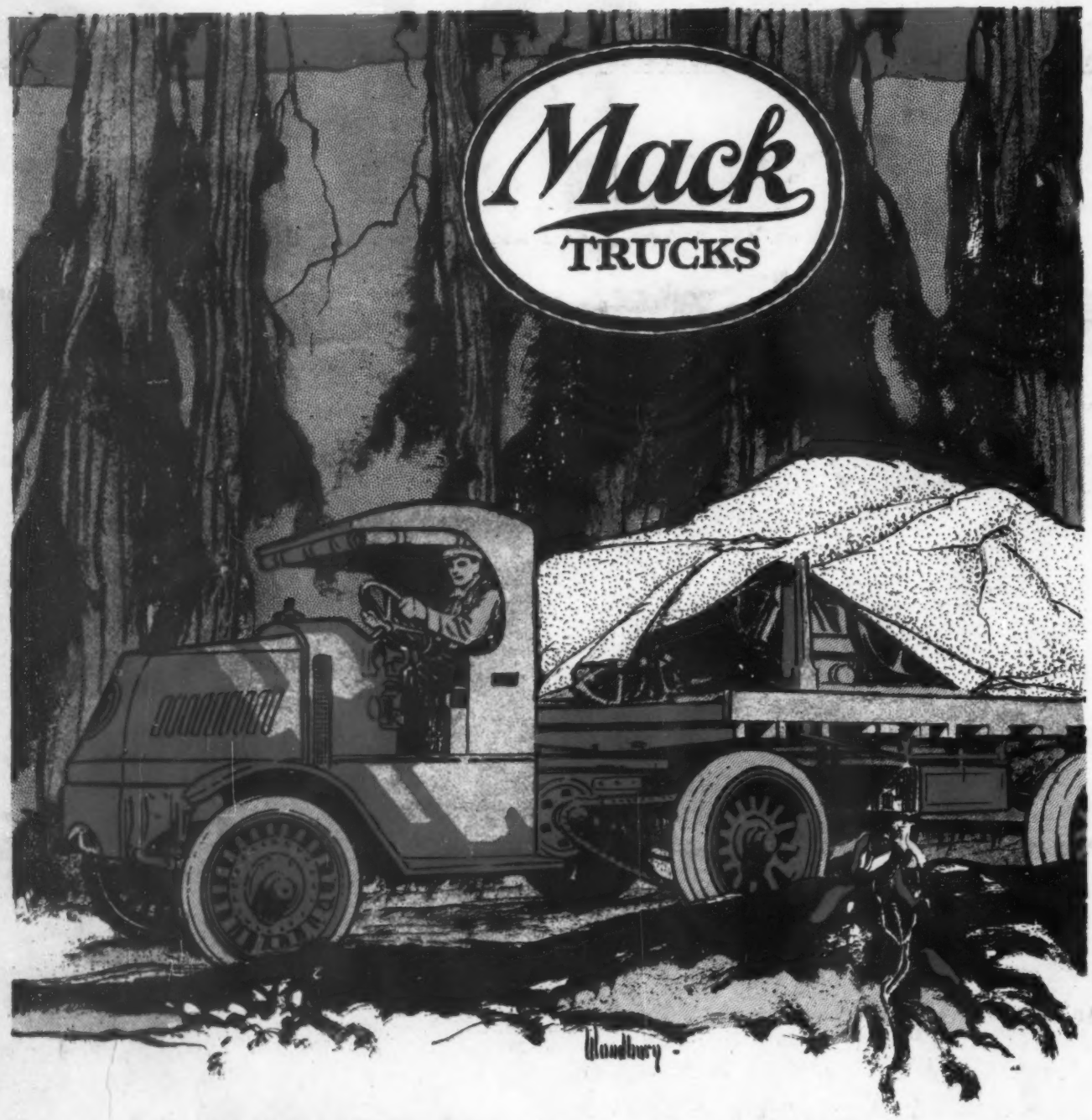

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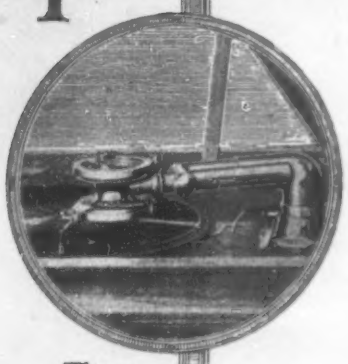

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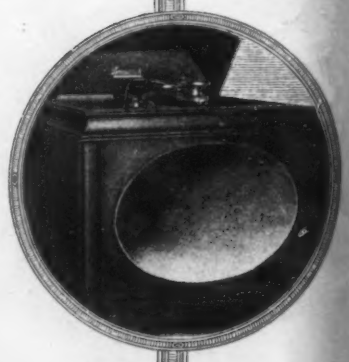

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